SM01

Standard Definition Video Encoder

and

Pattern Generator

User Manual

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Contents

Contents 2
Tables 3
Figures 3
1. Introduction 5
2. Connecting up the SM01 7
3. Quick Start Guide 10
    Switch On and Control 10
    Menu control 12
4. SM01 Patterns 19
    75% Colour bars 19
    100% Colour bars 20
    SMPTE Colour bars (NTSC only) 21
    75% Bars + Red (PAL only) 23
    Ramp 23
    10-step staircase (960H only) 24
    5-step staircase 25
    CCIR330 (PAL only) 25
    N7CMPF (NTC-7 Composite, NTSC only) 26
    CCIR17 (PAL only) 27
    2T20TPB (960H only) 28
    Black 28
    White 28
    Pedestal (525 line), 50% F/F (625 line) 28
    Bounce 29
    Sweep 29
    FCCMB (NTSC only) 30
    CCIR18 (PAL only) 30
    Multi (960H only) 31
    N7CMBF (NTC-7 Combination – NTSC only) 32
    CCIR331 (PAL only) 32
    Gamut 33
    Pathological (NTSC/PAL only) 34
    Bowtie (960H only) 34
    Matrix 35
    Zone Plate 36
    H sweep/V sweep/Zone Pl (NTSC1280/PAL1280 only) 39
    H Freq (NTSC1280/PAL1280 only) 40
5. SM01 Noise generator 41
Appendix A: SM01 specification 42

Appendix B: Power supply specification 60

Tables

Table 1 CVBS output specification. 8
Table 2 Analogue Component output Specifications 9
Table 3 SDI Output Specifications 9
Table 4 SDI Input specification. 9
Table 5 SM01 Patterns. 15
Table 6 75% colour bars composite output levels. 20
Table 7 100% colour bars composite levels. 21
Table 8 NTSC/PAL timing specifications. 43

Figures

Figure 1 SM01 rear panel. 7
Figure 2 SM01 AC-DC converter 8
Figure 3 SM01 Front panel. 10
Figure 4 SM01 Menu structure. 12
Figure 5 75% Component colour bar waveform. 19
Figure 6 100% Colour bar waveform. 20
Figure 7 SMPTE Colour Bar component waveform 22
Figure 8 SMPTE Reverse colour bars waveform 22
Figure 9 SMPTE Pluge waveform 23
Figure 10 Limit ramp waveform. 24
Figure 11 960H 10-step waveform. 24
Figure 12 5-step staircase waveform. 25
Figure 13 CCIR330 waveform. 26
Figure 14 N7CMPF (NTC-7) Component Waveform 27
Figure 15 CCIR17 Waveform 28
Figure 16 Sweep Waveform 29
Figure 17 FCCMB Waveform 30
Figure 18 CCIR18 Waveform 31
Figure 19 N7CMBF Component Waveform 32
Figure 20 CCIR331 Waveform 33
Figure 21 Gamut Waveform 33
Figure 22 Bowtie waveform. 34
Figure 23 Bowtie markers waveform. 35
Figure 24 Matrix test signal 36
Figure 25 The circular zone plate. 37
Figure 26 The zone plate horizontal frequency response. 38

Figure 27 Left side: The zone plate shows flickering colours at the subcarrier frequency as the line comb fails on the zone plate image. 39
Figure 28 Hum generator. 41
Figure 29 PAL horizontal timing (composite output). 43
Figure 30 PAL vertical timing (composite output). 44
Figure 31 NTSC Horizontal timing (composite output). 45
Figure 32 NTSC Vertical timing (composite output). 46
Figure 33 NTSC 75% colour bar composite output. 47
Figure 34 NTSC 75% colour bars vectors 48
Figure 35 PAL 75% colour bars (composite output) 49
Figure 36 PAL 75% colour bars vectors 50
Figure 37 NTSC K_Factor measurement. 51
Figure 38 NTSC NTC-7 Luma/Chroma delay/gain measurement 52
Figure 39 NTSC Differential gain/phase measurement. 53
Figure 40 NTSC noise measurement (Pedestal waveform). 54
Figure 41 Luma frequency response (CCIR18 test signal). 55
Figure 42 Chrominance non-linearity (using N7C-Combination test signal). 56
Figure 43 SDI output 525 line format measurement 57
Figure 44 SDI output 625 line format measurement 57
Figure 45 SDI output 625 line eye pattern 58
Figure 46 SDI output 625 line jitter measurement 59
Figure 47 AC-DC converter specification: Page 1 60
Figure 48 AC-DC converter specification: Page 2 61
Figure 49 AC-DC converter specification: Page 3 62

1. Introduction

SM01 is a video encoder and pattern generator supporting standard definition video standards.

As a video pattern generator, SM01 can generate 15 NTSC, 15 PAL and 15 960H line based patterns, a zone plate generator, and a programmable 12MHz maximum horizontal frequency sweep. These are output as simultaneous SDI (SMPTE-259M – NTSC/PAL only), YPbPr component, NTSC-M/J/443 or PAL-M/60 (for 525 line standards) or PAL-BG/I or PAL-N (for 625 line standards) or 960H (NTSC or PAL) or 1280H (NTSC or PAL – zone plate, vertical and horizontal sweep only) formats.

Patterns available include:

- 75%/100%/SMPTE/Bars+Red colour bars
- Black/White/50% grey flat fields
- 2T, 20T and Pulse bar
- CCIR17/18/330 and 331
- FCC Comp and FCC MB
- N7C MBF and N7C MPF
- Ramp
- Multi-burst
- Horizontal (up to 12MHz) and Vertical Sweeps
- 5/10 step linearity
- Pathological (SDI test)
- Gamut
- Bowtie
- Circular Zone Plate

In addition programmable amplitude noise may be added to the CVBS pattern output. Noise can be 50Hz or 60Hz hum and/or white noise.

As a video encoder SM01 accepts 525 or 625 line SMPTE-259M inputs which it encodes to simultaneous SDI (SMPTE-259M), YPbPr component and NTSC-M/J/443, PAL-M/PAL-60 (525 line standards) or PAL-BG/I, PAL-N (for 625 line standards). Again noise may be added to the CVBS output.

Controls provided include:

- CVBS amplitude
- CVBS Luma amplitude
- CVBS Chroma amplitude
- CVBS Burst amplitude
- CVBS Sync amplitude
- CVBS Black level
- NTSC Hue (Chroma phase)
- CVBS subcarrier frequency
- YPbPr Luma amplitude
- YPbPr Chroma amplitude
- YPbPr Sync amplitude
- YPbPr Black level

SM01 is powered by a universal input power supply and controlled with a simple and intuitive selection menu.

2. Connecting up the SM01

All connections to the SM01 are made via the rear panel: see Figure 1.

Figure 1 SM01 rear panel.

The AC-DC converter connects to the left hand jack. The SM01 input is protected against reverse polarity. The converter supplied with the SM01 is a model MW173KB manufactured by SL Power Electronics Corp. and provides 9VDC at 3A and accepts AC inputs from 100-240VAC. Connect the supplied power cord to the AC-DC converter and output DC of the converter to the **9VDC Power In** input of the SM01.

Figure 2 SM01 AC-DC converter

A full specification for the supplied AC-DC converter may be found in Appendix B.

The SM01 provides both analogue and digital component outputs for connecting to the equipment under test.
The CVBS (NTSC/PAL) output is connected to the BNC, 'CVBS Out'. The specification for the output is shown in Table 1. The composite output specification is detailed in Appendix A.

Parameter	Specification	Comments
Connector Type	**BNC**	
Output impedance	**75Ω**	
Output return loss	**>30dB**	**0-5MHz**
CVBS output level	**1.0V pk.pk**	**Nominal peak Y to sync tip for 100% colour bars input**

Table 1 CVBS output specification.

The analogue component outputs are connected to the BNCs, 'Y Out', 'Pb Out' and 'Pr Out'. The specification for the outputs is shown in Table 2. The component output specification is detailed in Appendix A.

Parameter	Specification	Comments
Connector Type	BNC	
Output impedance	75Ω	
Output return loss	>30dB	0-5MHz
Y output level	1.0V pk.pk	Nominal 100% colour bars input
Cb/Cr output levels	700mV pk-pk	Nominal 100% colour bars input

Table 2 Analogue Component output Specifications

The serial digital interface (SDI) output is connected to the 'SDI Out' BNC and its specifications are shown in Table 3.
The SDI output conforms to the SMPTE-259M specification. The SDI output specification is detailed in Appendix A.

Parameter	Specification	Comments
Connector Type	BNC	
Output impedance	75Ω	Fixed termination
Output return loss	>15dB	50Hz-270MHz
Output level	800mV pk-pk ± 10%	
Jitter	<0.2UI	

Table 3 SDI Output Specifications

The serial digital interface (SDI) input (only used in encoder mode) is connected to the 'SDI In' BNC and its specifications are shown in Table 4.
The SDI input conforms to the SMPTE-259M specification.

Parameter	Specification	Comments
Connector Type	BNC	
Input impedance	75Ω	Fixed termination
Input return loss	>15dB	50Hz-270MHz
Input level	800mV pk-pk	Nominal

Table 4 SDI Input specification.

3. Quick Start Guide

Switch On and Control

Connect the AC-DC converter 9VDC cable into the rear panel power in socket. Connect the AC supply to a local AC supply between 110-240VAC. The **Standby** LED should light. Push the **Adjust** control and the unit will switch on and the welcome message will be displayed (**SingMai SM01**).

To switch off the SM01 push the **Adjust** control again.

The front panel of the SM01 is shown in Figure 3.

Figure 3 SM01 Front panel.

There are just two controls for the SM01. The right hand control (**Adjust**) switches the unit between On and Standby by pushing it whilst also adjusting the value of parameters by rotating the knob left or right. The central switch (**Select**) selects the chosen menu parameter and switches preset parameters between, for example, on and off.

After the welcome message ('SingMai, SM01') is displayed for a few seconds the LCD display will show the available top level menus. A left hand arrow indicates which menu is 'active'. Rotating the **Adjust** control will show all the available menus; after the last of the menus an up arrow is shown.

To select a menu ensure the left arrow is by the side of the required top level menu and press the **Select** button. Those menu options will then be displayed.

To change a parameter within the lower menu choices choose the required item by aligning the left arrow with it and press the **Select** button. The parameter will either toggle between the available options (e.g. On or Off) or will show a menu bar where to can select more options via the **Adjust** control. Once you have chosen the setting you require press the **Select** button to return to the menu choices.

The **Adjust** control is also used to set the parameter values. Once set the required value, press the **Select** button to retain that value and return to the menu.

To return to the top level menu scroll down the menu choices using the **Adjust** control; the last one before the up arrow will show **Exit**. Select this by pressing the **Select** button and you will return to the top level menus.

Menu control

The complete menu structure is shown in Figure 4.

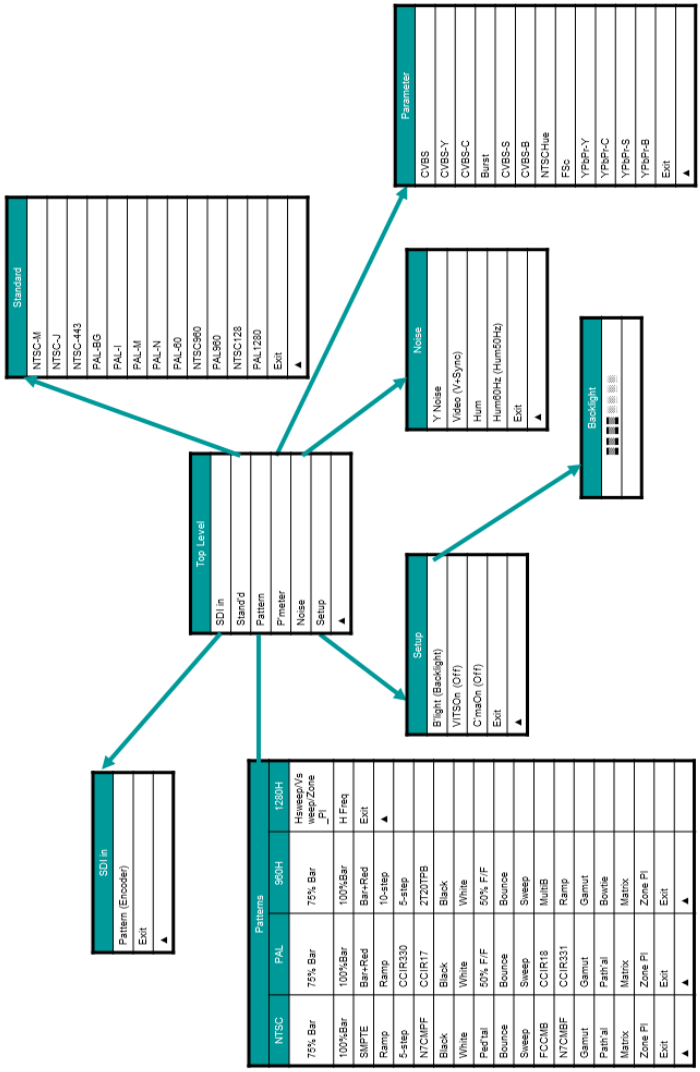


Figure 4 SM01 Menu structure.

The following is a brief description of the menu functions.

SDI in:

Pattern (Encoder)
Each button press toggles between the internal patterns (Pattern – default value) and the serial digital (SDI) input (Encoder).
(Note: the SDI input is not operative for the 960H or 1280H standards.)

Exit
Returns to the top level menus.

Stand'd (Standard):

In Encoder mode the SDI input standard must match the output standard selection. (i.e. if the SDI input is 625 line standard, selecting NTSC-M/J/443/PAL-60 or PAL-M will result in corrupted outputs).

NTSC-M
Forces NTSC-M output standard for the composite output and 525 line standard for the YPbPr and SDI outputs. (Default value)

NTSC-J
Forces NTSC-J output standard for the composite output and 525 line standard for the YPbPr and SDI outputs. (NTSC-J is the Japanese version of NTSC, which has no setup and different output levels to NTSC-M).

NTSC443
Forces NTSC443 output standard for the composite output and 525 line standard for the YPbPr and SDI outputs. (NTSC-443 is a playback 'standard' which has NTSC timing characteristics with a 4.433MHz PAL subcarrier frequency).

PAL-BG
Forces PAL-BG output standard for the composite output and 625 line standard for the YPbPr and SDI outputs.

PAL-I
Forces PAL-M output standard for the composite output and 525 line standard for the YPbPr and SDI outputs.

(Note the difference between PAL-BG and PAL-I is only the front porch value).

PAL-N
Forces PAL-N output standard for the composite output and 625 line standard for the YPbPr and SDI outputs.

PAL-60
Forces PAL-60 output standard for the composite output and 525 line standard for the YPbPr and SDI outputs. (PAL-60 has NTSC timing characteristics but with a PAL 4.43 subcarrier frequency and PAL phase alternate line switching).

NTSC960
Forces NTSC-M output standard for the composite output and 525 line standard for the YPbPr outputs. (Note the 960H sampling frequency is 36MHz).

PAL-960
Forces PAL-BG output standard for the composite output and 625 line standard for the YPbPr outputs. (Note the 960H sampling frequency is 36MHz).

NTSC128
Forces NTSC-M output standard for the composite output and 525 line standard for the YPbPr outputs. (Note the 1280H sampling frequency is 54MHz).

PAL1280
Forces PAL-BG output standard for the composite output and 625 line standard for the YPbPr outputs. (Note the 1280H sampling frequency is 54MHz).

Exit
Returns to the top level menus.

The specifications for the standards are shown in Appendix A.

Pattern:

Selects the output pattern when in ‘Pattern’ mode. (In ‘Encoder’ mode the pattern menu cannot be selected.)

The patterns available depend on the standard selected. Table 5 lists the patterns available for each standard. A full description of the patterns can be found in Chapter 4.

Patterns			
NTSC	PAL	960H	1280H
75% Bar	75% Bar	75% Bar	Hsweep/Vsweep/Zone_PI
100%Bar	100%Bar	100%Bar	H Freq
SMPTE	Bar+Red	Bar+Red	Exit
Ramp	Ramp	10-step	▲
5-step	CCIR330	5-step	
N7CMPF	CCIR17	2T20TPB	
Black	Black	Black	
White	White	White	
Ped'tal	50% F/F	50% F/F	
Bounce	Bounce	Bounce	
Sweep	Sweep	Sweep	
FCCMB	CCIR18	MultiB	
N7CMBF	CCIR331	Ramp	
Gamut	Gamut	Gamut	
Path'al	Path'al	Bowtie	
Matrix	Matrix	Matrix	
Zone PI	Zone PI	Zone PI	
Exit	Exit	Exit	
▲	▲	▲	

Table 5 SM01 Patterns.

P’meter (Parameter):

Note that some combinations of the parameter settings can give invalid outputs and may result in clipping of the signal.

CVBS
Adjusts the output amplitude of the composite video output. Default value is 100% (gain of 1). Range is 0-130%.

CVBS-Y
Adjusts the output amplitude of the luma component of the composite video output. Default value is 100% (gain of 1). Range is 0-130%.

CVBS-C
Adjusts the output amplitude of the chroma component of the composite video output. Default value is 100% (gain of 1). Range 0-130%.

Burst
Adjusts the output amplitude of the colour burst of the composite video output. Default value is 100% (gain of 1). Range 0-130%.

CVBS-S
Adjusts the output amplitude of the synchronizing signals of the composite video output. Default value is 100% (gain of 1). Range is 0-130%.

CVBS-B
Adjusts the output black level of the composite video output. Default value is pedestal value for NTSC-M or 0mV for other standards). Default value is 0 (offset of 0mV). Range is ±100.

NTSCHue
Adjusts the phase of the chroma component (hue) for composite video output (NTSC-M/-J/-443 only). Default value is 0deg. Range is ±180deg.

FSc
Adjusts the frequency of the subcarrier for the composite video output. Default value is 0Hz. Range is ±400Hz.

YPbPr-Y
Adjusts the output amplitude of the luma (Y channel) of the component YPbPr analogue video output. Default value is 100% (gain of 1). Range is 0-130%.

YPbPr-C
Adjusts the output amplitude of the chroma (Pb/Pr) of the component YPbPr analogue video output. Default value is 100% (gain of 1). Range is 0-130%.

YPbPr-S
Adjusts the output amplitude of the synchronizing signals of the component Y analogue video output. Default value is 100% (gain of 1). Range is 0-130%.

YPbPr-B
Adjusts the black level value of the luma component of the component YPbPr analogue video output. Default value is 100 (offset of 0mV). Range is ±100.

Exit
Returns to the top level menus.

Noise:

Y Noise
Selects a sub menu which allows control of the amplitude of white noise injected into the Y output channel of the CVBS analogue output only. The range of the control is from 0 (off – default value) to 100 (maximum noise). A fuller description of the noise generator may be found in Chapter 5.

Video (V+Sync)
The injected noise (white noise) is limited to the active video portion of the analogue output waveform (Video – default value) or the entire waveform (V+Sync).

Hum
Selects a sub menu which allows control of the amplitude of hum injected into the CVBS analogue output. The range of the control is from 0 (off – default value) to 100 (maximum hum). A fuller description of the noise generator may be found in Chapter 5.

Hum60Hz (Hum50Hz)
Selects frequency of the hum (50Hz or 60Hz).

Exit
Returns to the top level menus.

Setup:

B'light
Controls the brightness of the front panel LCD backlight. Default value is '4'.

VITSOn (VITSOff)
Inserts the CCIR17, CCIR18, CCIR330 and CCIR331 test patterns onto lines 17, 18, 330 and 331 respectively of the PAL output standard if enabled (VITSOn) or the N7CMBF and N7CMPF onto line 17 of fields 1 and 2 respectively of the NTSC standard. Default value is VITS on.

C'maOn (C'maOff)
Turns off the chroma component of the CVBS output and sets the Pb/Pr outputs of the analogue component output to blanking level if set (C'maOff). Default value is chroma on (C'maOn).

Exit
Returns to the top level menus.

4. SM01 Patterns

Below is a detailed description of each of the SM01 patterns.
(**Note**: The NTSC/PAL 1280H standards only provide a set of programmable frequency sweeps that allow the performance of this standard's extended luma bandwidth to be measured. The description of these patterns are at the end of this chapter.)

75% Colour bars

75% colour bars are used for measuring insertion gain, chroma level and chroma gain and for monitor alignment. The SM01 generates full frame 75% saturated colour bars with a 100% white bar reference and 7.5 IRE setup (for the NTSC-M/PAL-M composite output only). The colour bar sequence is white, yellow, cyan, green, magenta, red, blue and black.

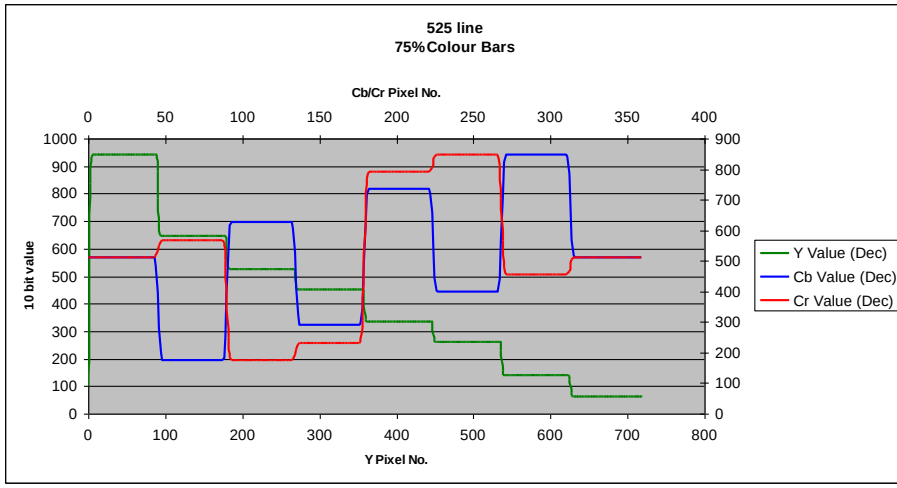


Figure 5 75% Component colour bar waveform.

The output levels for the composite bar waveform are shown below.

mV	NTSC-M(J) / PAL-M 100/7.5/75/7.5		PAL / PAL-N 100/0/75/0	
	Luminance	Chrominance	Luminance	Chrominance
White	714.29(714.29)	0.00(0.00)	700.00	0.00
Yellow	492.62(474.64)	443.34(479.29)	465.15	470.50
Cyan	400.94(375.54)	626.69(677.50)	368.03	663.81
Green	344.45(314.46)	585.18(632.63)	308.18	620.09

mV	NTSC-M(J) / PAL-M 100/7.5/75/7.5		PAL / PAL-N 100/0/75/0	
	Luminance	Chrominance	Luminance	Chrominance
Magenta	258.22(221.25)	585.18(632.63)	216.83	620.09
Red	201.73(160.18)	626.69(677.50)	156.98	663.81
Blue	110.06(61.07)	443.34(479.29)	59.85	470.50
Black (Setup)	53.57(0.00)	0.00(0.00)	0.00	0.00

Table 6 75% colour bars composite output levels.

100% Colour bars

100% colour bars are used for measuring insertion gain, chroma level and chroma gain and for monitor alignment. The SM01 generates full frame 100% saturated colour bars with a 100% white bar reference and 7.5 IRE setup (for the composite output only). The colour bar sequence is white, yellow, cyan, green, magenta, red, blue and black.

Note that 100% NTSC colour bars will cause clipping in the transmitter and they are therefore only used within a studio 'closed system'.

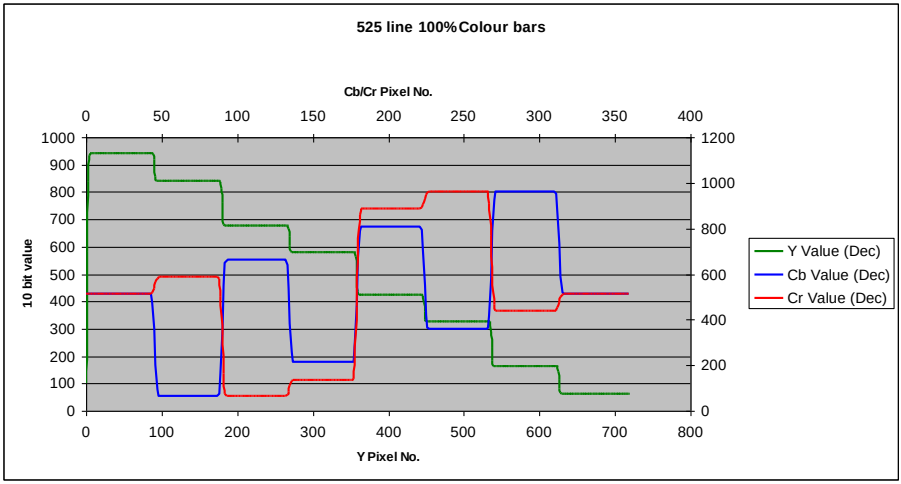


Figure 6 100% Colour bar waveform.

The output levels for the composite bar waveform are shown below.

mV	NTSC-M(J) / PAL-M 100/7.5/100/7.5		PAL / PAL-N 100/0/100/0	
	Luminance	Chrominance	Luminance	Chrominance
White	714.29(714.29)	0.00(0.00)	700.00	0.00
Yellow	638.96(632.86)	591.12(639.05)	620.20	627.33
Cyan	516.73(500.71)	835.58(903.33)	490.70	885.08
Green	441.41(419.28)	780.24(843.50)	410.90	826.79
Magenta	326.44(295.00)	780.24(843.50)	289.10	826.79
Red	251.13(213.57)	835.58(903.33)	209.30	885.08
Blue	128.89(81.43)	591.12(639.05)	79.80	627.33
Black (Setup)	53.57(0.00)	0.00(0.00)	0.00	0.00

Table 7 100% colour bars composite levels.

SMPTE Colour bars (NTSC only)

67% of the SMPTE colour bar waveform comprises 75% colour bars; white, yellow, cyan, green, magenta, red and blue. Below this and comprising 8% of the frame, is a sequence of blue, black, magenta, black, cyan, black, white bars. The function of these bars is to set monitor chroma gain and phase – the red and green monitor outputs are switched off and the monitor hue (chroma phase) is adjusted to equalize the cyan/magneta and magenta/cyan vertical transitions. The chroma saturation is then used to equalize the transition between white/blue vertical transition.

The bottom 25% of the SMPTE pattern is, from left to right, -I, white, Q, black and pluge.
The pluge (±4 IRE bars) is used to set up the monitor black level; the whiter than black bar should be visible, the blacker than black bar should not. The –I and Q elements of the SMPTE pattern are longer used.

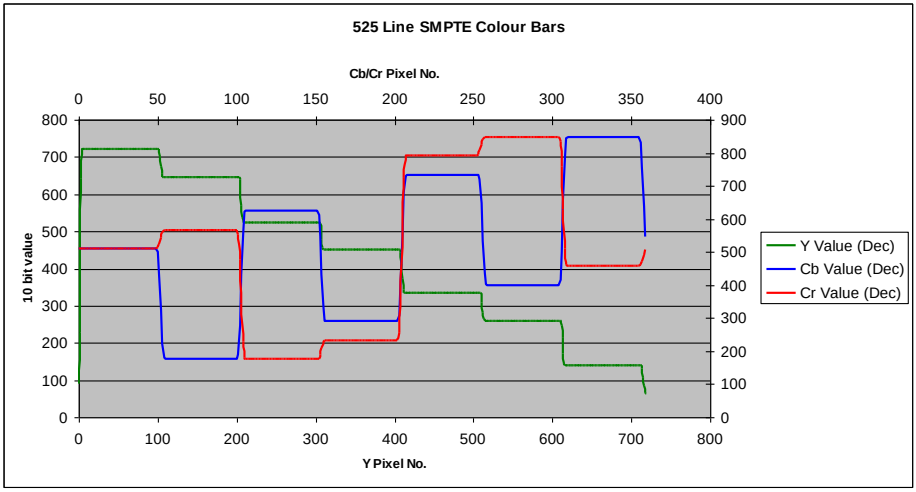


Figure 7 SMPTE Colour Bar component waveform

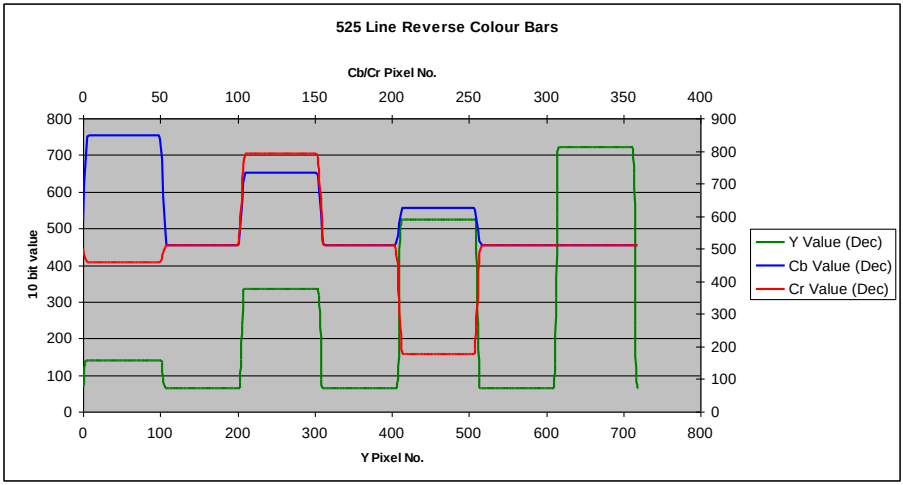


Figure 8 SMPTE Reverse colour bars waveform

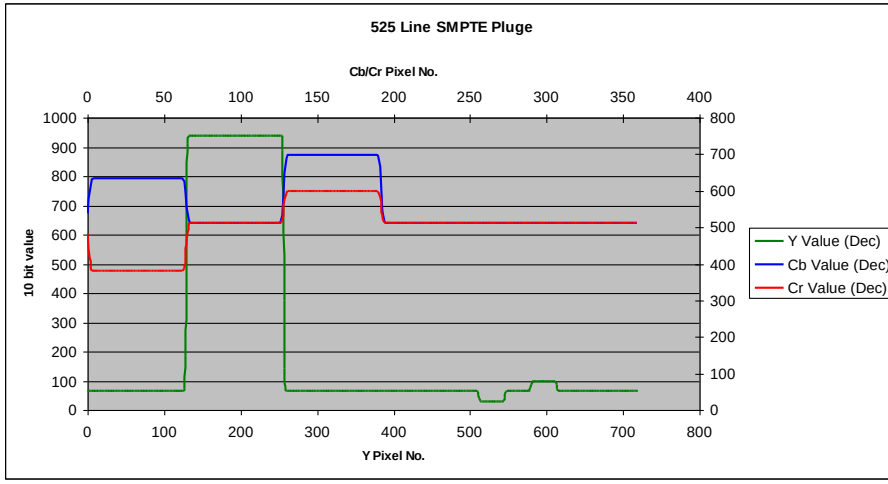


Figure 9 SMPTE Pluge waveform

75% Bars + Red (PAL only)

The top half of this pattern is 75% colour bars, as described above. The bottom half is a 75% saturation red field.

Ramp

This waveform is a linear modulated ramp and may be used to measure linearity as well as differential gain and phase.

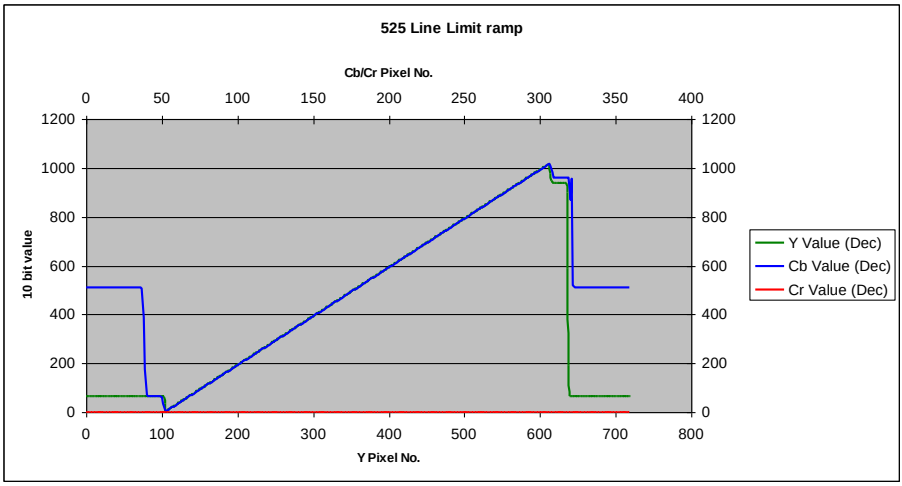


Figure 10 Limit ramp waveform.

10-step staircase (960H only)

This waveform is ten, equal amplitude, steps of luma and chroma and may be used to measure linearity as well as differential gain and phase.

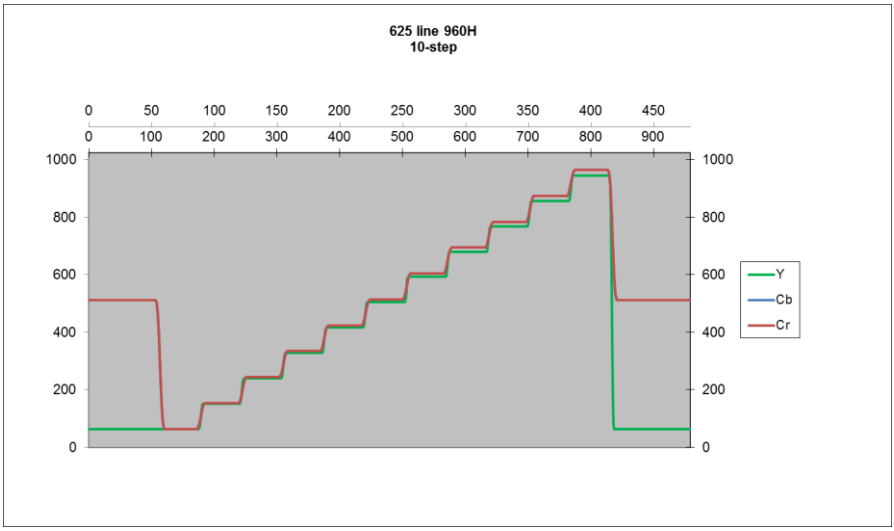


Figure 11 960H 10-step waveform.

5-step staircase

This waveform is five, equal amplitude, steps of luma and chroma and may be used to measure linearity as well as differential gain and phase.

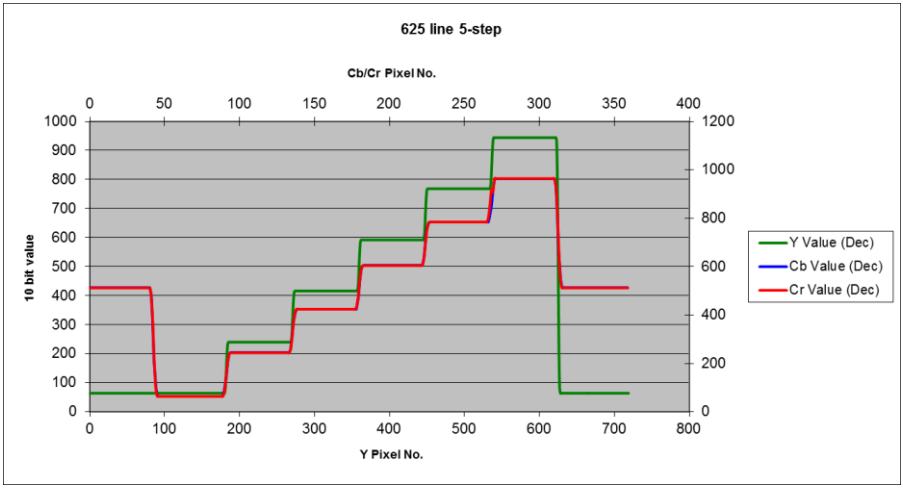


Figure 12 5-step staircase waveform.

CCIR330 (PAL only)

This waveform is one of the four PAL vertical interval test signals (VITS) and comprises a pulse and bar and modulated five-step staircase. It is used for the measurement of differential gain and phase.

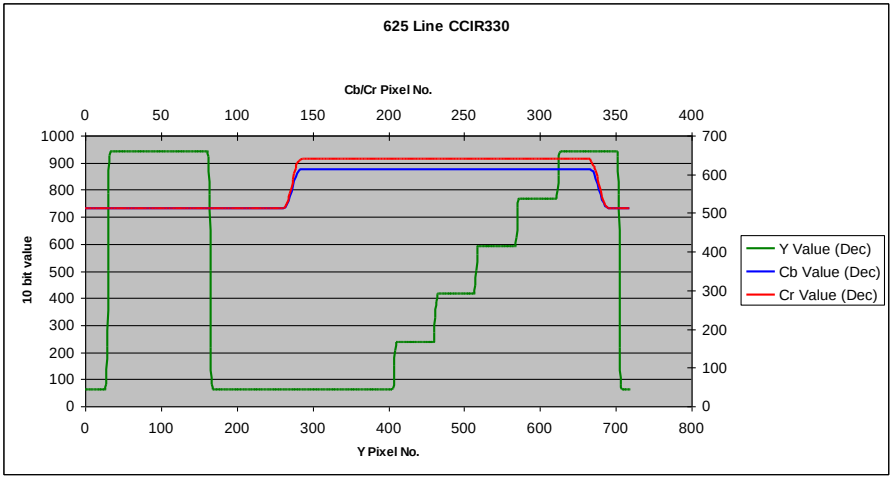


Figure 13 CCIR330 waveform.

The CCIR330 signal is inserted on line 330 of the CVBS output by enabling 'VITSOn' in the Setup menu, (default is on).

N7CMPF (NTC-7 Composite, NTSC only)

The NTC-7 pattern consists of a 100% white bar, 2T pulse, 12.5T chrominance pulse and a 5-step modulated staircase.

The 100% white bar can be used for gain calibrations and coupling distortion measurements (flat top to the bar). The 2T pulse is used for measuring distortion in the system group delay (the delay vs. frequency response of system). The 12.5T chroma pulse may be used for measuring relative luma to chroma delay and gain and the 5-step staircase is used to measure differential gain (the difference in amplitude between each step in the staircase and the colour burst) and differential phase (the difference in phase between each step in the staircase and the colour burst).

N7CMPF is one of the NTSC test signals and is inserted on line 17, field 1 of the CVBS output by enabling 'VITSOn' in the Setup menu, (default is on).

Measurements using the NTC-7 composite signal can be seen in Appendix A.

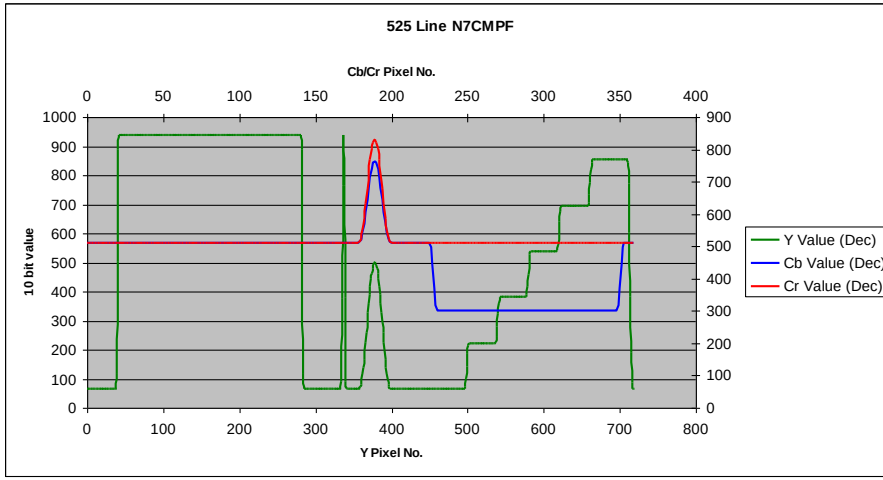


Figure 14 N7CMPF (NTC-7) Component Waveform

CCIR17 (PAL only)

The CCIR17 pattern consists of a 100% reference luminance bar followed by 2T and 20T pulses and a 5 step luminance staircase. The pattern may be used for the measurement of K-factor, luma/chroma gain/delay and luminance linearity.

The CCIR17 signal is also inserted on line 17 of the output signal by enabling 'VITSOn' in the Setup menu, (default is on).

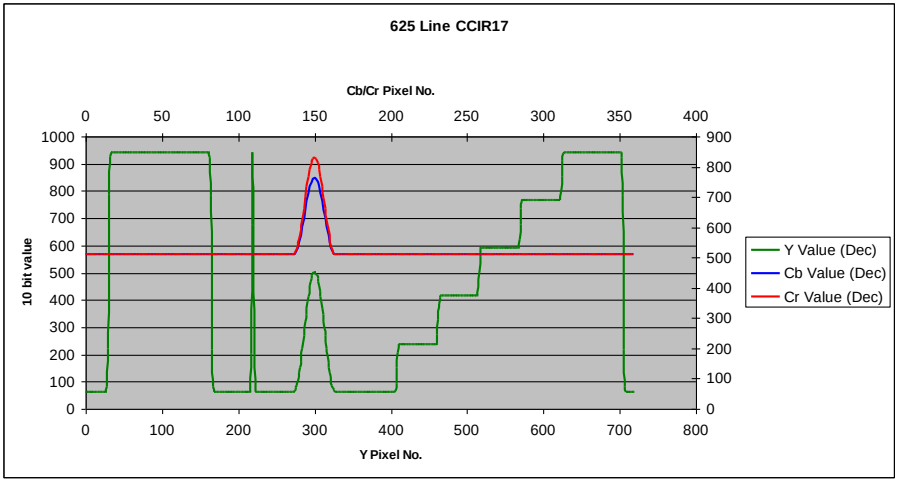


Figure 15 CCIR17 Waveform

2T20TPB (960H only)

The 2T20TPB signal is a pulse, bar and two pulses, 2T and 20T wide. It allows the measurement of K-factor and luma/chroma gain and delay. A separate signal to the CCIR17 and NTC-7 waveforms is created because 960H has a wider bandwidth (e.g. 18MHz luma sampling, compared to 13.5MHz luma sampling for NTSC/PAL).

Black

Black is a full frame 0 IRE (NTSC-M) or 0mV (PAL) video signal that may be used for noise measurements.

White

White is a full frame 100 IRE (NTSC-M) or 700mV (PAL) video signal that may be used for noise measurements or for finding AC coupling or clamping issues.

Pedestal (525 line), 50% F/F (625 line)

Pedestal is a full frame 50 IRE (NTSC) or 350mV (50%, PAL) video signal that may be used for noise measurements. The noise measurement of the

SM01 using this signal and measured with the Tektronix VM700 is shown in Appendix A.

Bounce

The bounce test signal switches between black and white test signals at field frequency (50 or 60Hz). It is used to measure field time distortion or detect clamping issues.

Sweep

Sweep is a swept frequency waveform used for testing the system frequency response.
For PAL/NTSC the frequency range is 0.25MHz to 5.75MHz for luma and 0.125MHz to 2.75MHz for chroma.
For 960H the frequency range is 0.25MHz to 7.75MHz for luma and 0.125MHz to 2.75MHz for chroma.

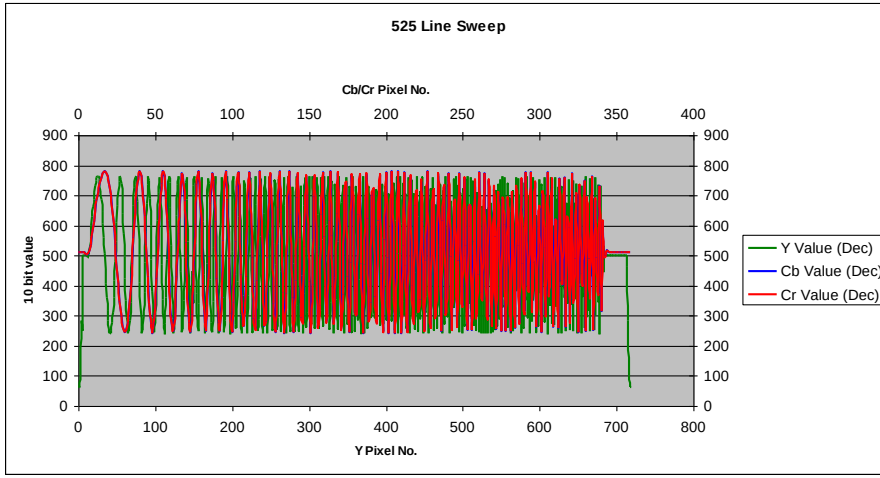


Figure 16 Sweep Waveform

FCCMB (NTSC only)

The FCCMB test signal is a pulse reference followed by six frequency packets at 0.5MHz, 1.25MHz, 2.0MHz, 3.0MHz, 3.579545MHz and 4.1MHz.

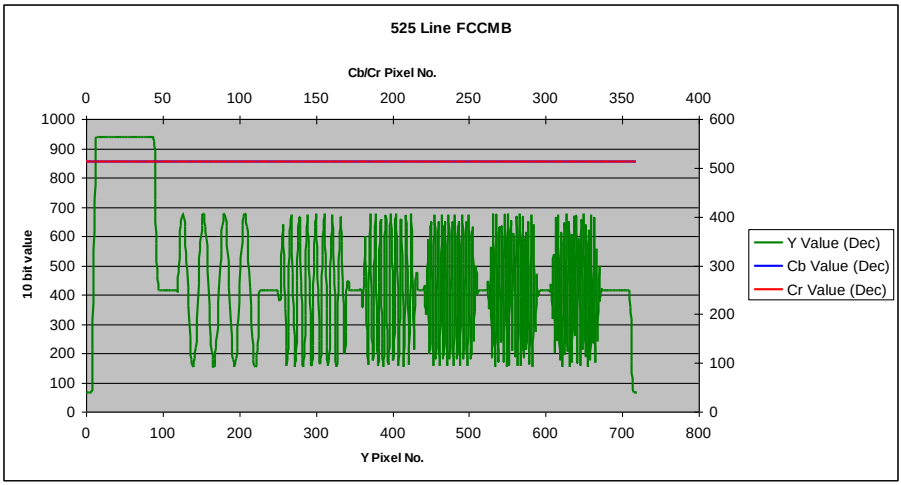


Figure 17 FCCMB Waveform

CCIR18 (PAL only)

The CCIR18 pattern is a standard VITS, (Vertical Interval Test Signal), pattern consisting of a luminance reference bar followed by 6 multi-burst packets at 0.5MHz, 1.0MHz, 2.0MHz, 3.0MHz, 4.8MHz and 5.8MHz of 60% amplitude on a 50% pedestal.

The CCIR18 signal is inserted on line 18 of the output signal by enabling 'VITSOn' in the Setup menu, (default is on).

The frequency response of the SM01 measured with the CCIR18 test signal is shown in Appendix A.

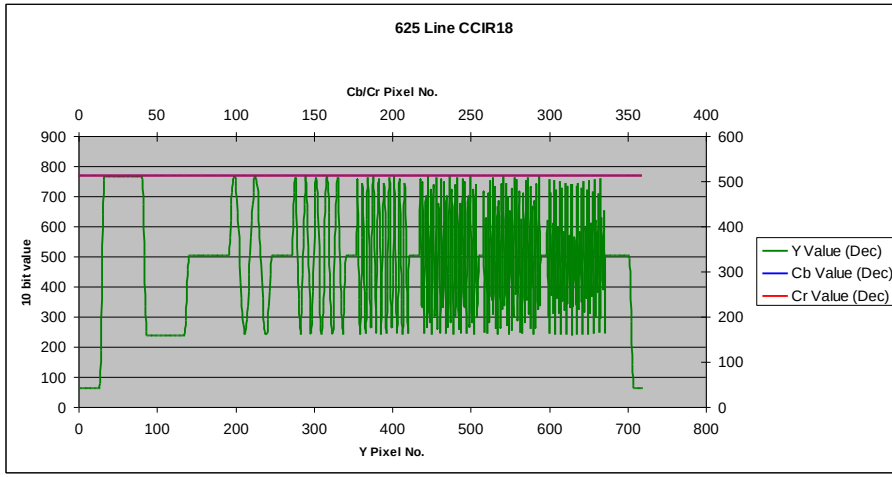
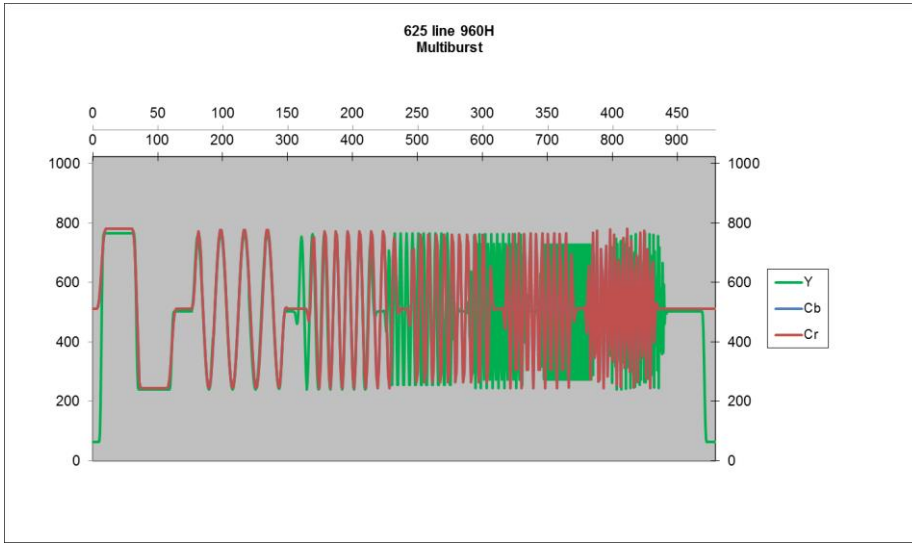


Figure 18 CCIR18 Waveform

Multi (960H only)

The FCCMB test signal is a pulse reference followed by six luma frequency packets at 0.5MHz, 1.0MHz, 2.0MHz, 4.0MHz, 6.0MHz and 7.75MHz. The chroma signal comprises 5 packets at 0.5MHz, 1.0MHz, 1.5MHz, 2.0MHz and 2.75MHz.



N7CMBF (NTC-7 Combination – NTSC only)

The NTC-7 Combination pattern consists of a white bar at 100 IRE, 6 multiburst packets of 50 IRE amplitude on a 50 IRE pedestal (at 0.5MHz, 1.0MHz, 2.0MHz, 3.0MHz, 3.58MHz and 4.2MHz) and a 20,40 and 80 IRE amplitude modulated chrominance on a 50 IRE pedestal. The latter can be used to measure chrominance linearity as shown in Appendix A.

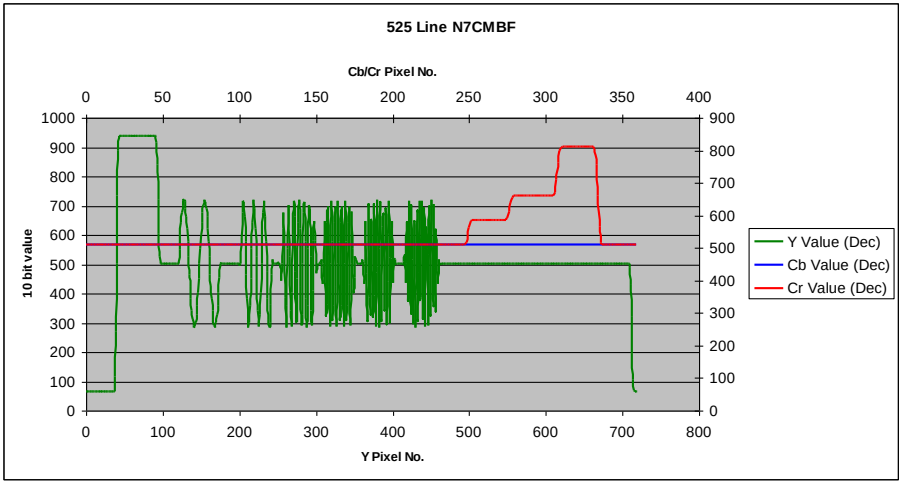


Figure 19 N7CMBF Component Waveform

CCIR331 (PAL only)

The CCIR331 signal is used to measure chroma amplitude and phase errors as well as luma/chroma intermodulation. It is a vertical interval test signal (VITS) and is inserted on line 331 of the output signal by enabling 'VITSOn' in the Setup menu, (default is on).

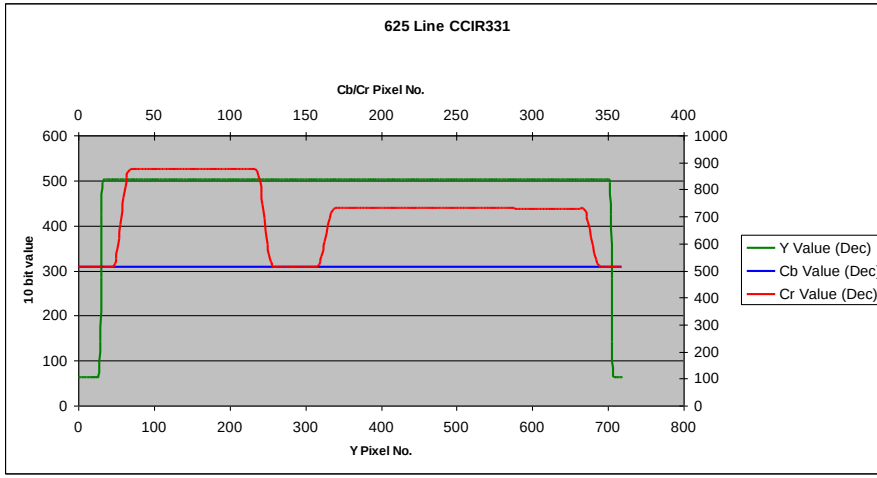


Figure 20 CCIR331 Waveform

Gamut

The gamut test signal is designed to detect errors in converting between different colour spaces (e.g. from Y,Cb,Cr to RGB).

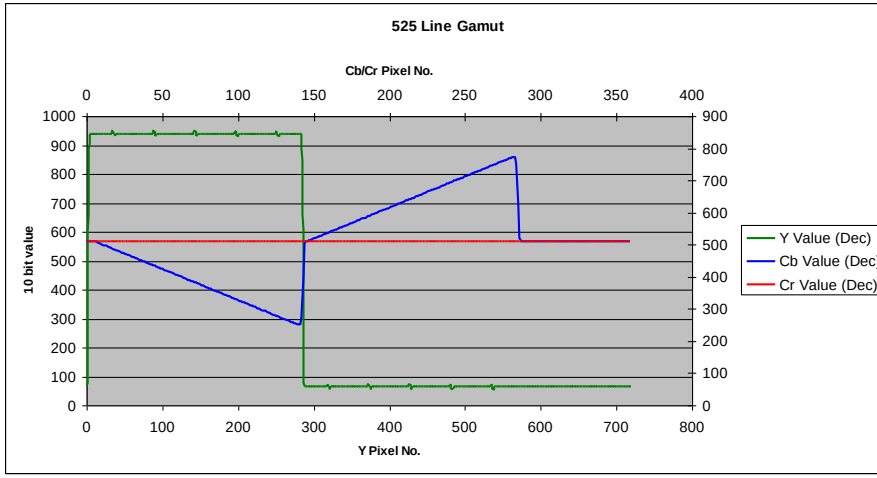


Figure 21 Gamut Waveform

Pathological (NTSC/PAL only)

The pathological output is intended for stressing the equalizer of an SDI receiver. The pattern is in accordance with SMPTE-259M. The pattern consists of two parts, split horizontally into the top and bottom halves of a field as shown in Figure 41.
The top half consists of a repetitive active line pattern of values Y=198h and C=300h. After scrambling this results in either 19 ‘ones’ followed by one ‘zero’ or 19 ‘zeros’ followed by one ‘one’. This output stresses the equalizer because of its low frequency content.
The bottom half consists of a repetitive active line pattern of values Y=110h and C=200h. This results in an output with 20 ‘zeros’ followed by 20 ‘ones’. This bit pattern tests the receiver PLL because of the low transition frequency of edges in the data.

Bowtie (960H only)

The Bowtie waveform is used to measure component amplitude and timing errors. The waveform consists of a 500kHz sine wave on the luma channel and a 502kHz sine wave on the Pb and Pr outputs. Marker signals are provided to assist in the measurement.

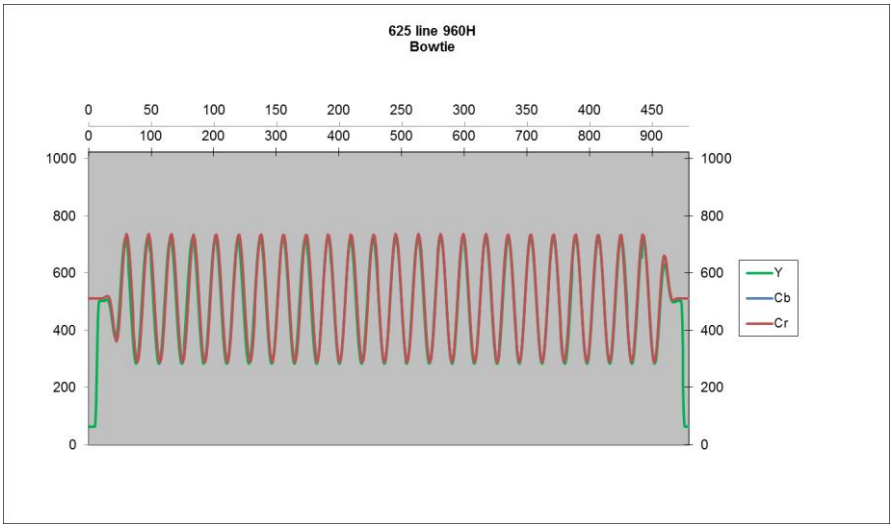


Figure 22 Bowtie waveform.

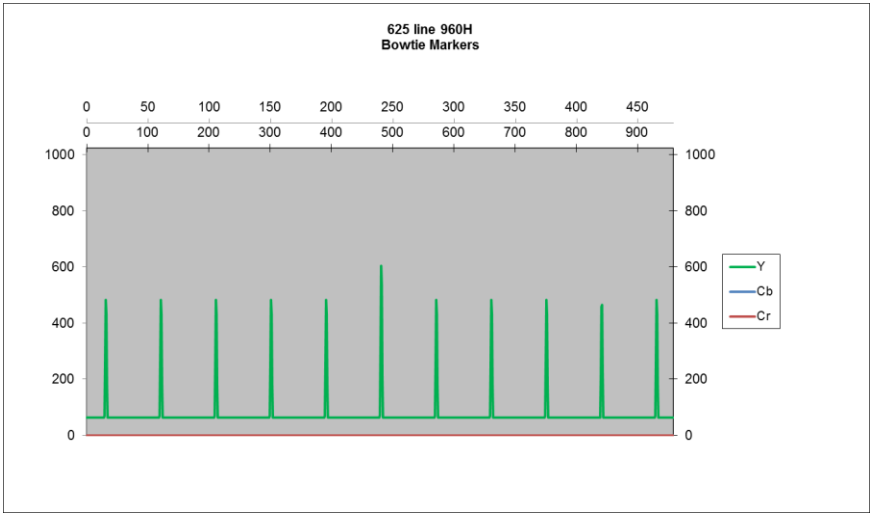


Figure 23 Bowtie markers waveform.

Matrix

The matrix test signal comprises five equally spaced patterns in one combination test signal that permits a single test signal analysis of a video component or system. The five signals are: 75% colour bars, 5 step modulated staircase, 2T/20T pulse and bar, luma multi-burst and modulated ramp.

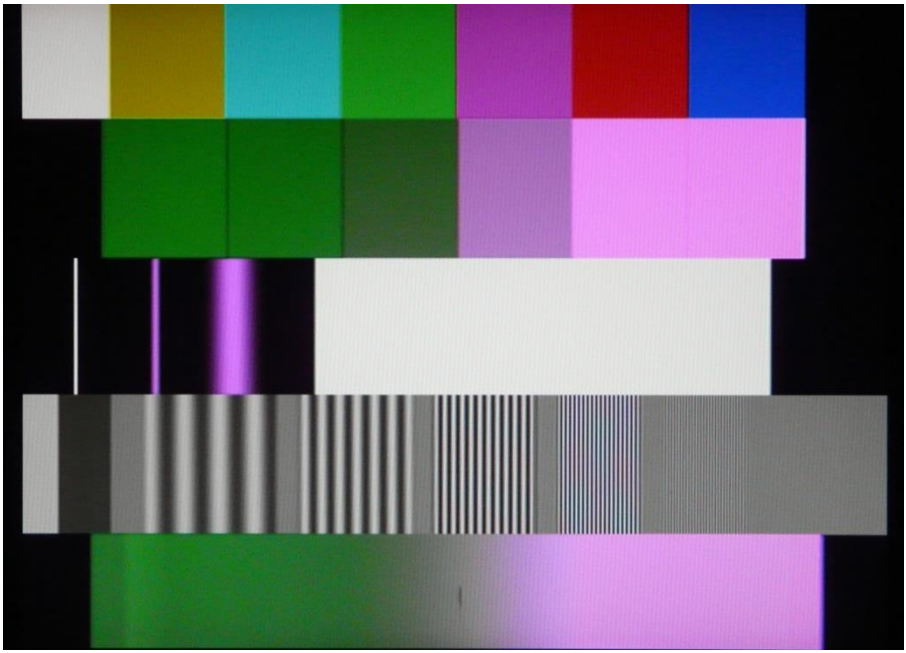


Figure 24 Matrix test signal.

Zone Plate

Those involved in optics are probably very familiar with the circular zone plate. It is shown in Figure 25.

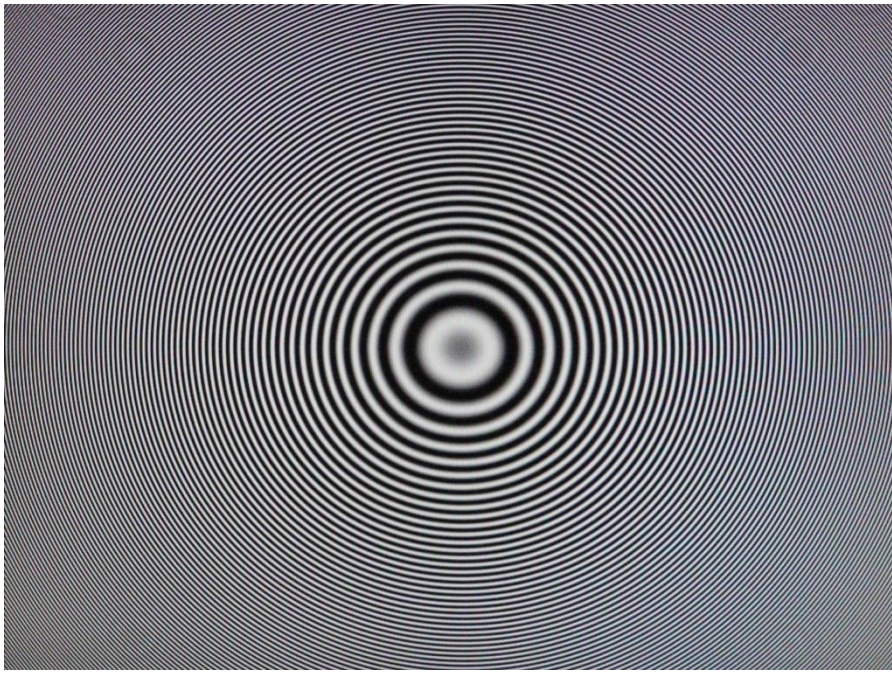


Figure 25 The circular zone plate.

The zone plate is a two-dimensional linear frequency sweep with the highest frequencies at the edges of the image. It can be used to measure the horizontal and vertical frequency response of system. For example, in figure 26, I show a horizontal line of video and you can clearly see that the left and right edges of the waveform droop, showing some high frequency attenuation.

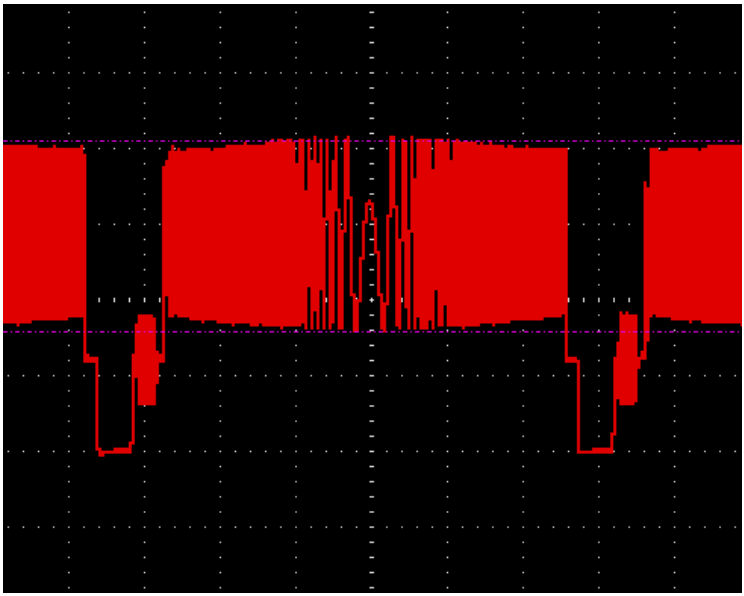


Figure 26 The zone plate horizontal frequency response.

Attenuation on the left and right edges of the image show low pass filtering of the image; attenuation of the top and bottom of the image show vertical filtering, perhaps line to line averaging or issues with a scaler or de-interlacer.

The zone plate is very useful for designing and testing composite analogue video decoders. Even a conventional line comb decoder will not be able to separate chominance and luminance of the same frequency because of the non-repetitive nature of the pattern (each horizontal line is different to the ones adjacent to it). This will result in cross-colour effects as shown in Figure 27.

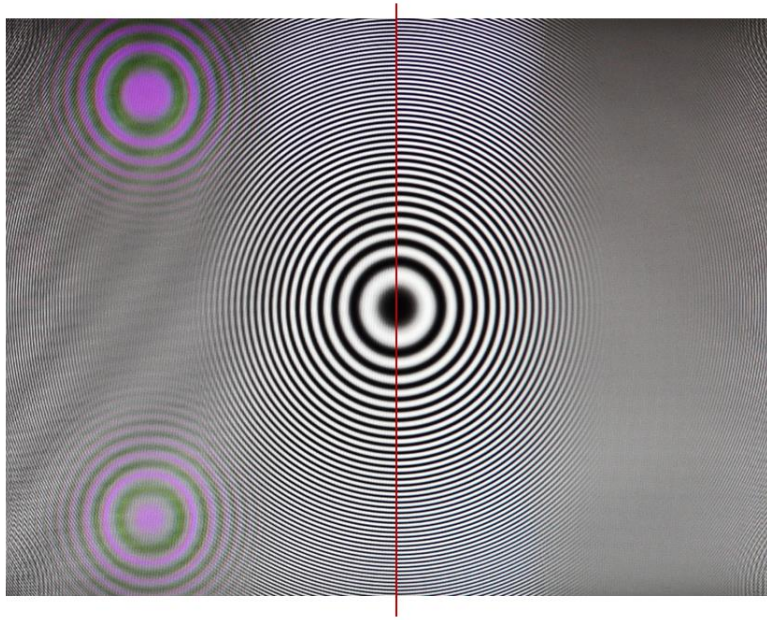


Figure 27 Left side: The zone plate shows flickering colours at the subcarrier frequency as the line comb fails on the zone plate image.

Although the frame comb decoder shows no artifacts when the zone plate is still, if we move the zone plate in time similar corruption of the image will occur. The moving zone plate is the test image from hell for an analogue video decoder. The position of the defect in the zone plate can tell us what the problem in the video processing can be, e.g. it can show us the frequency of an aliasing component.

The zone plate's use is not just restricted to analogue video decoding. Any video processing which manipulates the image spatially and/or temporally can be tested to breaking point with the zone plate: such processing includes video standards conversion, de-interlacing and scaling.

H sweep/V sweep/Zone Pl (NTSC1280/PAL1280 only)

Pressing the select button sequentially selects either a horizontal frequency sweep, a vertical frequency sweep or a circular zone plate pattern. The upper frequency of the horizontal sweep can be controlled using the 'H Freq' control.

H Freq (NTSC1280/PAL1280 only)

Selects the upper range of the horizontal frequency sweep (this option cannot be selected in vertical sweep or zone plate mode). The range is 0Hz (flat field) to 12.0MHz in 0.1MHz steps. The default value is 1.0MHz.

5. SM01 Noise generator

SM01 has two noise generators that can add noise to the CVBS output.

The first of these uses a pseudo-random number generator to create white noise. A programmable amount of this noise is added to the luma component of the composite output. The noise can be added to the entire video signal (including the sync and blanking) or just to the active video (using the Video/Video+S select option). The maximum noise setting adds approximately 50dB of noise to the signal.

The second noise generator is a programmable frequency (50Hz or 60Hz) hum generator. Figure 28 shows the hum generator on the CVBS output across a frame of video.

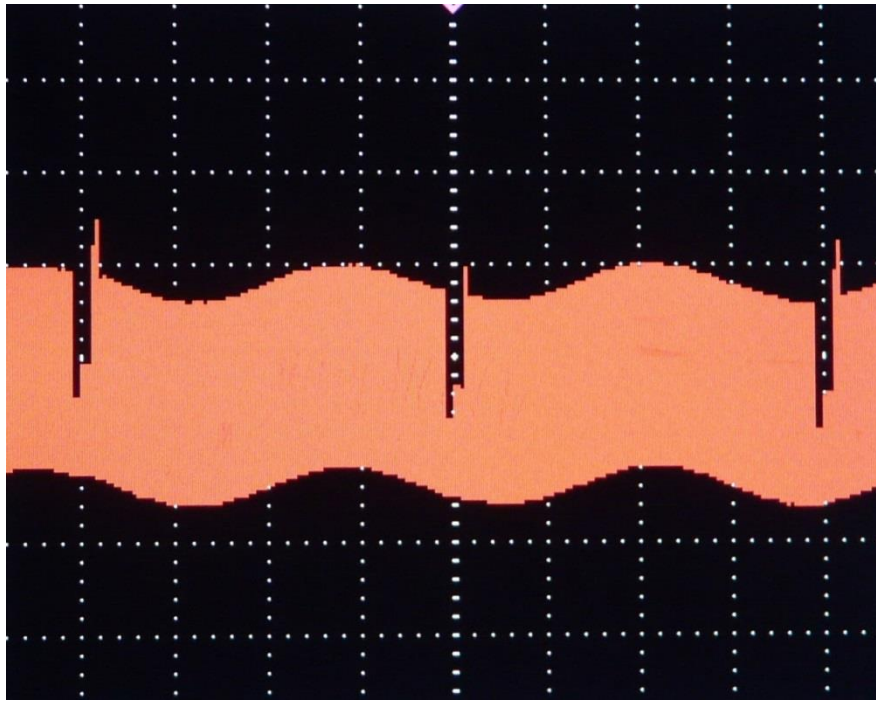


Figure 28 Hum generator.

Appendix A: SM01 specification

The SM01 CVBS specifications are shown in Table 8.

Parameter	Specification		Comments
	PAL B,G,I,N	NTSC-M/J, PAL-M	
Frame Rate/Field Rate	25Hz/50Hz	30Hz/60Hz	
Line Period	64us	63.555555us	
Lines/Frame	625	525	
Line Blanking Interval	12us	10.7us	
Front Porch	1.5us	1.5us	1.65us for PAL-I
Line sync pulse width	4.7us	4.7us	
Back Porch	5.8us	4.5us	
Equalising Pulse width	2.35us	2.3us	
Broad Pulse width	27.3us	27.0775us	
Rise/Fall times of sync edges	250ns	250ns	NTSC/PAL-M rise time should be 140ns.
Sync Pulse amplitude	300mV	40IRE	
Luminance white bar amplitude	700mV	100IRE	
Vertical Sync Group	7.5 lines	9 lines	
No. of equalizing pulses	5 + 5	6 + 6	
Chrominance Phase error	<1deg	<1.5deg	
Subcarrier Frequency	4.43361875MHz (PAL) 3.58205625MHz (PAL-N)	3.5795455MHz (NTSC) 3.5756118MHz (PAL-M)	
Colour Frame duration	8 fields	4 fields	8 fields for PAL-M
Burst start	5.64us	5.31us	5.3us for PAL-N

Burst duration	2.25us	2.51us	2.51us for PAL-N
Burst Amplitude	300mV	40IRE	
Differential Gain	<1%	<1%	Sin x/x corrected
Differential Phase	<1deg	<1deg	Sin x/x corrected
K Factor (2T)	<1%	<1%	
Chrominance luminance delay	< +/- 5ns	< +/- 5ns	
Signal to Noise ratio	-70dB (50% grey input)	-70dB (50% grey).	Unweighted

Table 8 NTSC/PAL timing specifications.

The measured horizontal and vertical output timings for PAL and NTSC composite outputs are shown in Figures 29 to 32.

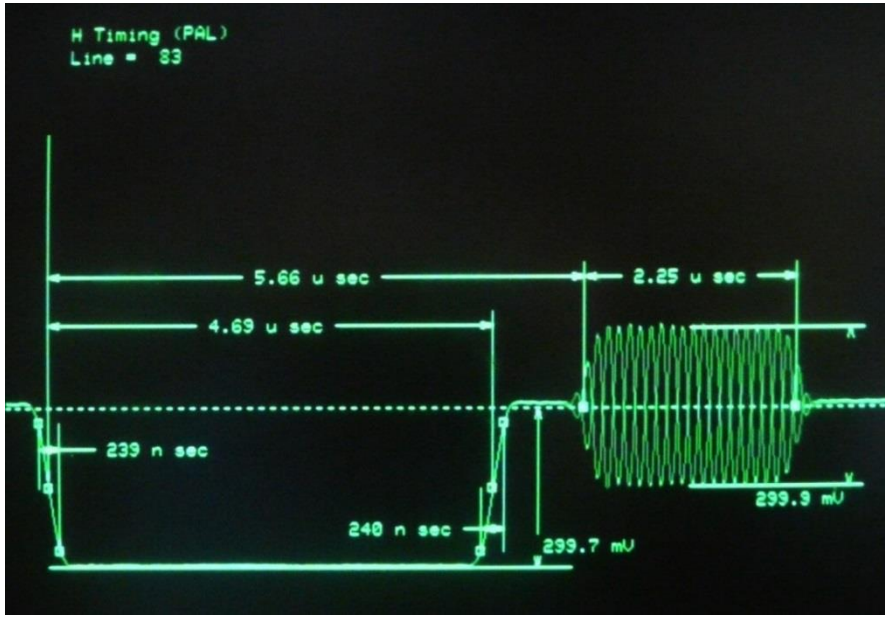


Figure 29 PAL horizontal timing (composite output).

Figure 30 PAL vertical timing (composite output).

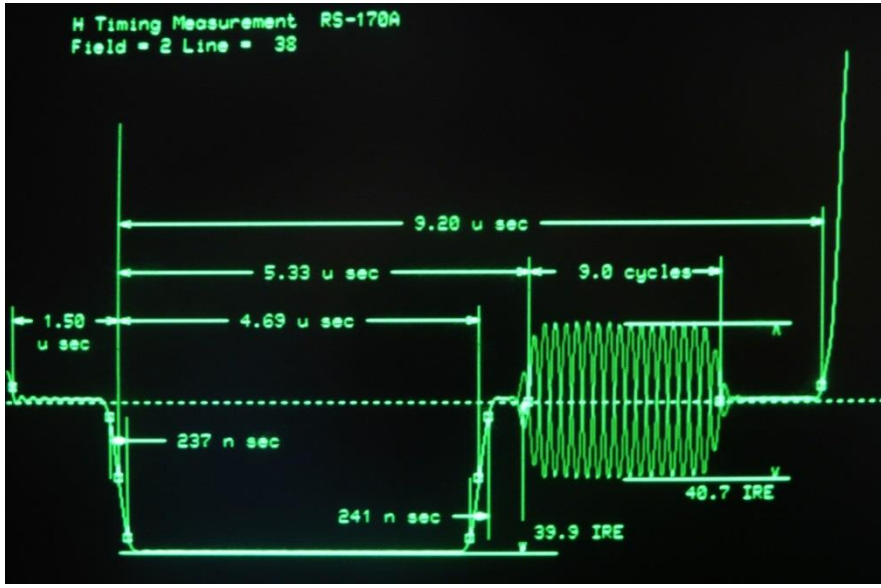


Figure 31 NTSC Horizontal timing (composite output).

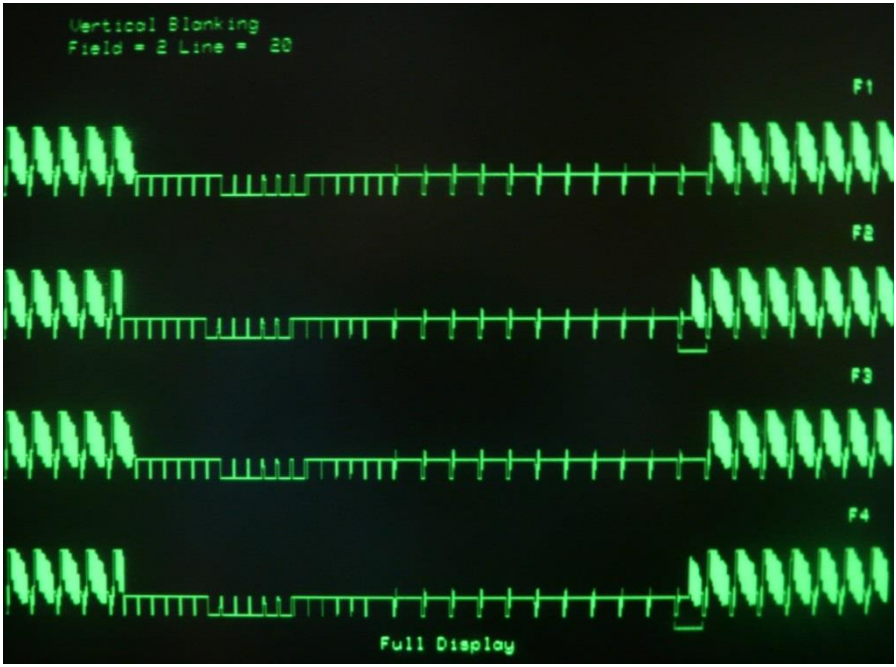


Figure 32 NTSC Vertical timing (composite output).

Figure 33, below, shows the 75% colour bar composite output of the SM01 compared with the reference levels of the Tektronix VM700 and the corresponding vector diagram in Figure 34.

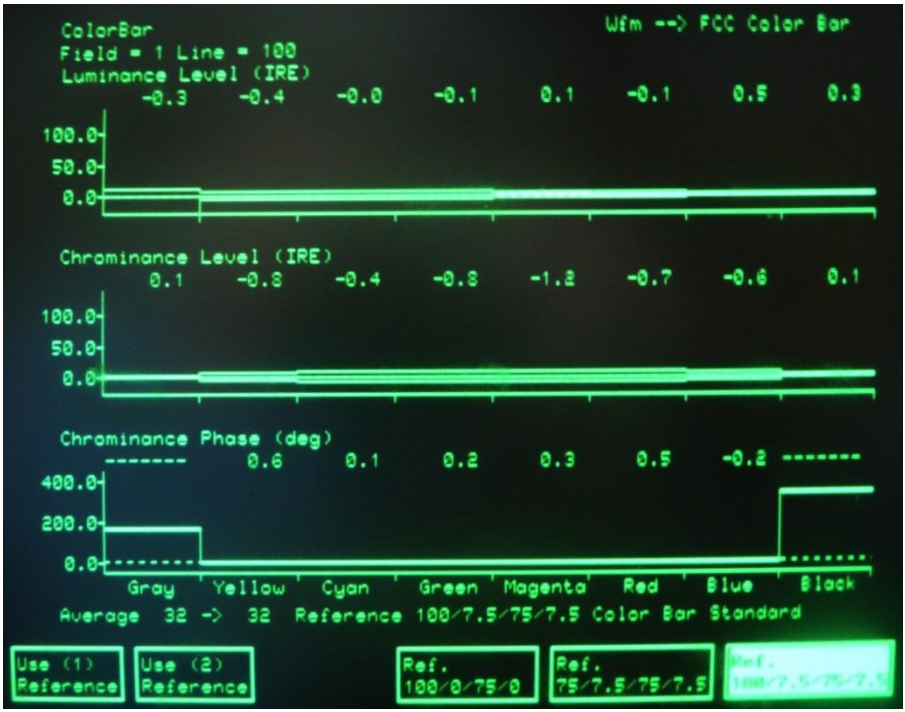


Figure 33 NTSC 75% colour bar composite output.

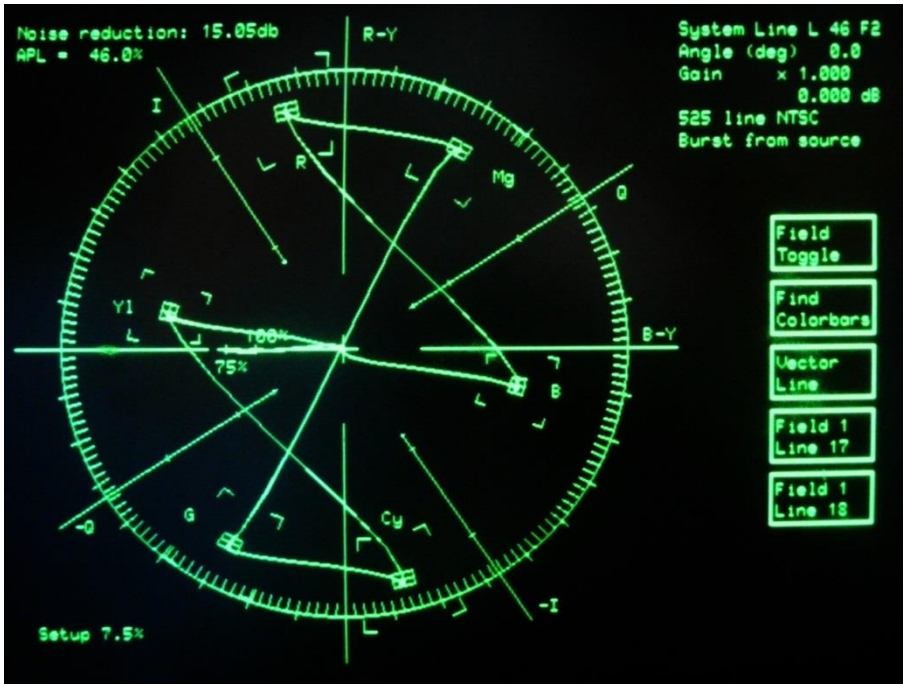


Figure 34 NTSC 75% colour bars vectors

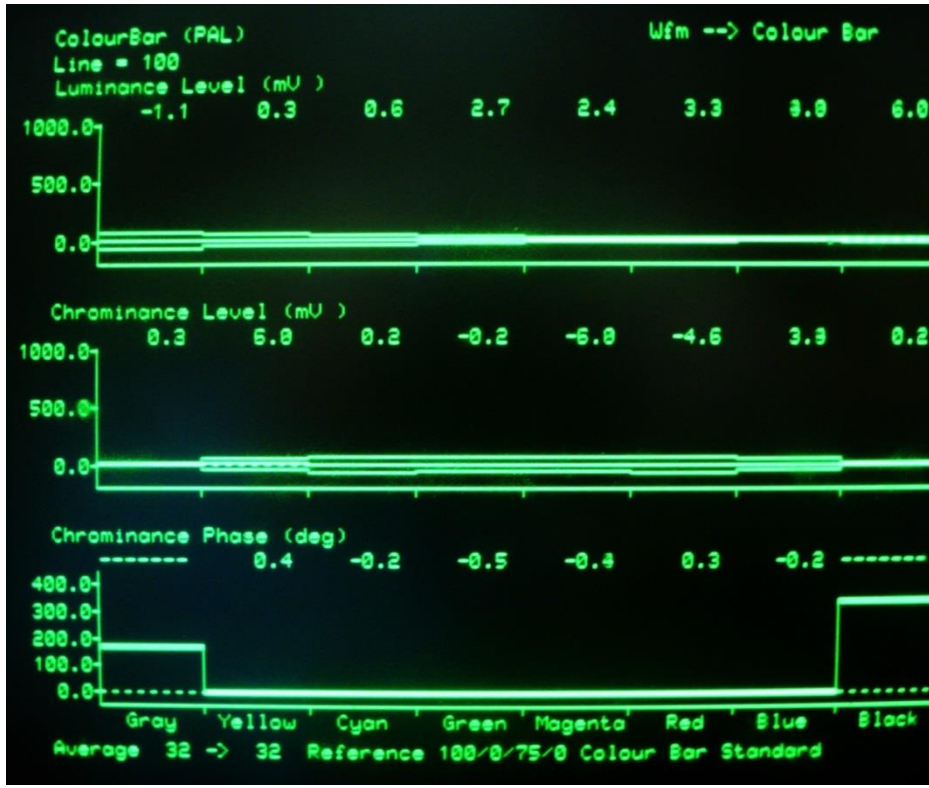


Figure 35 PAL 75% colour bars (composite output)

Figure 36 PAL 75% colour bars vectors

Figure 37 shows the K-factor (2T pulse) distortion measurement for the SM01 measured on a Tektronix VM700 using the NTC-7 Composite test signal.

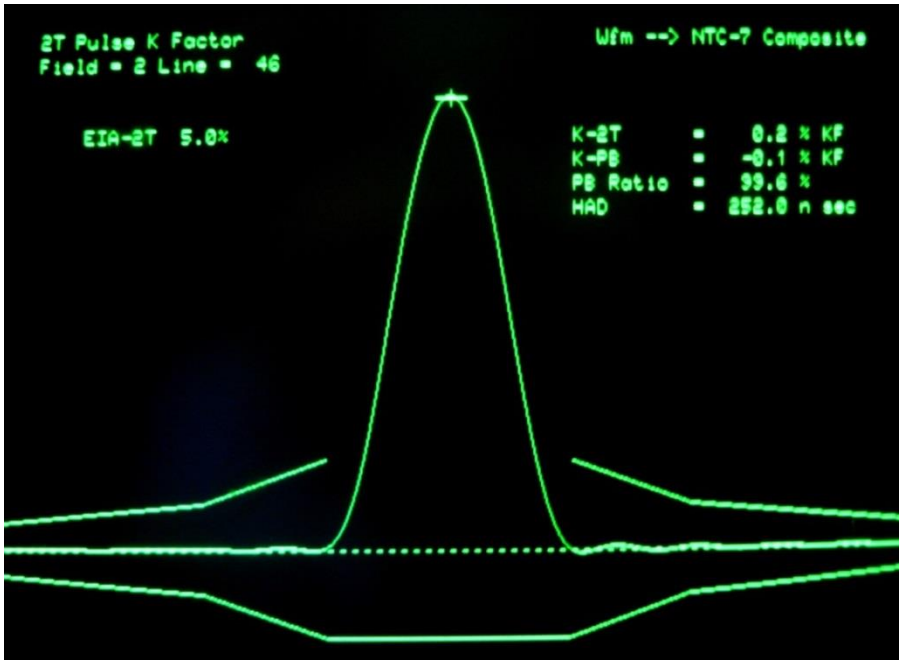


Figure 37 NTSC K_Factor measurement.

Figure 38 shows the luma/chroma delay and gain measurement for the SM01 measured on a VM700 using the NTC-7 Composite test signal.

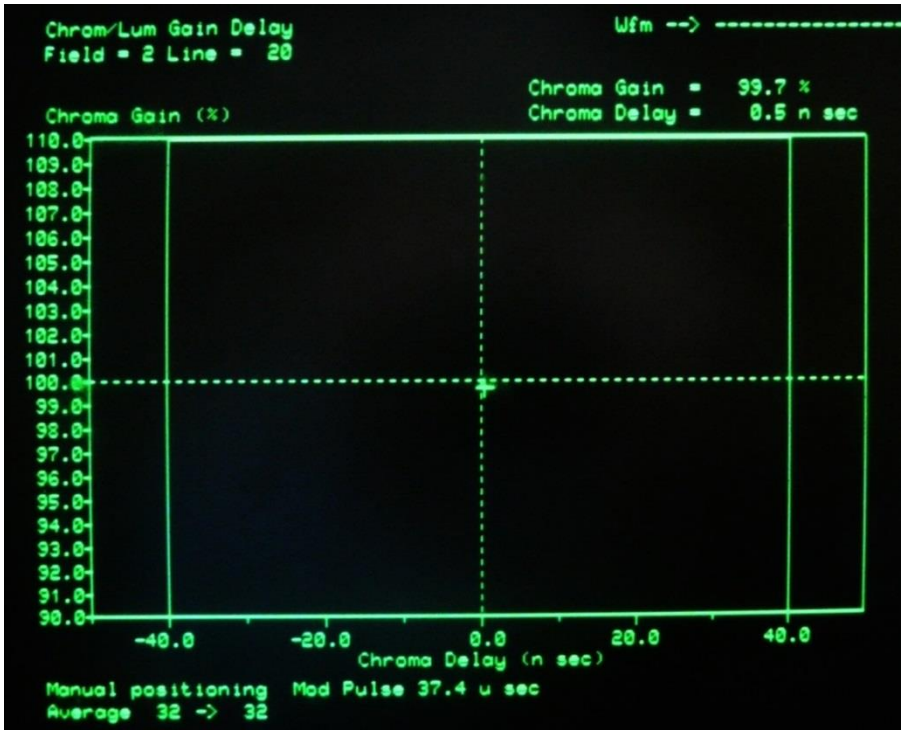


Figure 38 NTSC NTC-7 Luma/Chroma delay/gain measurement

Figure 39 shows the differential gain and phase measurements for the SM01, measured using the Tektronix VM700 on the NTC-7 waveform.

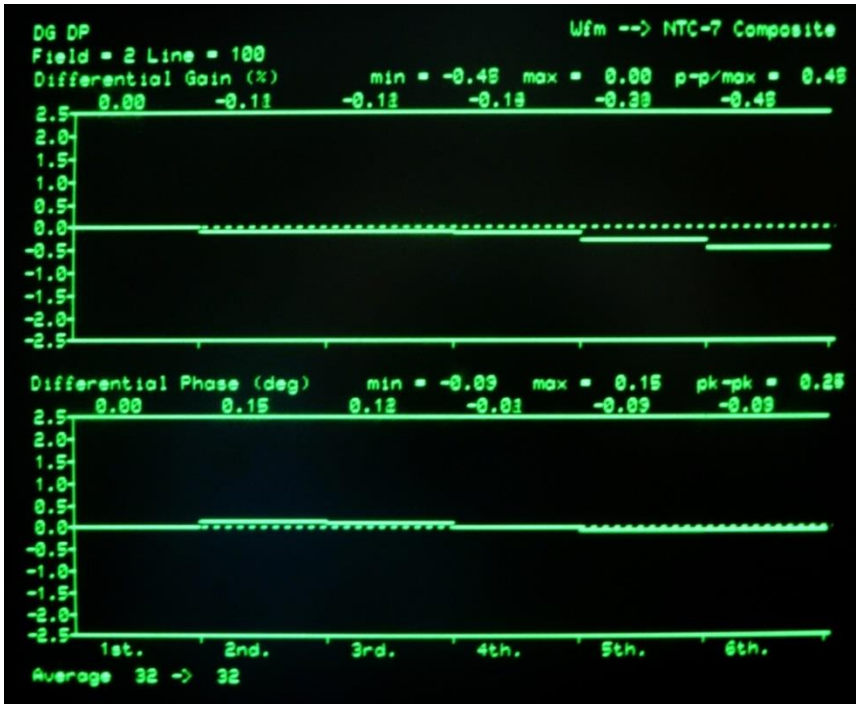


Figure 39 NTSC Differential gain/phase measurement.

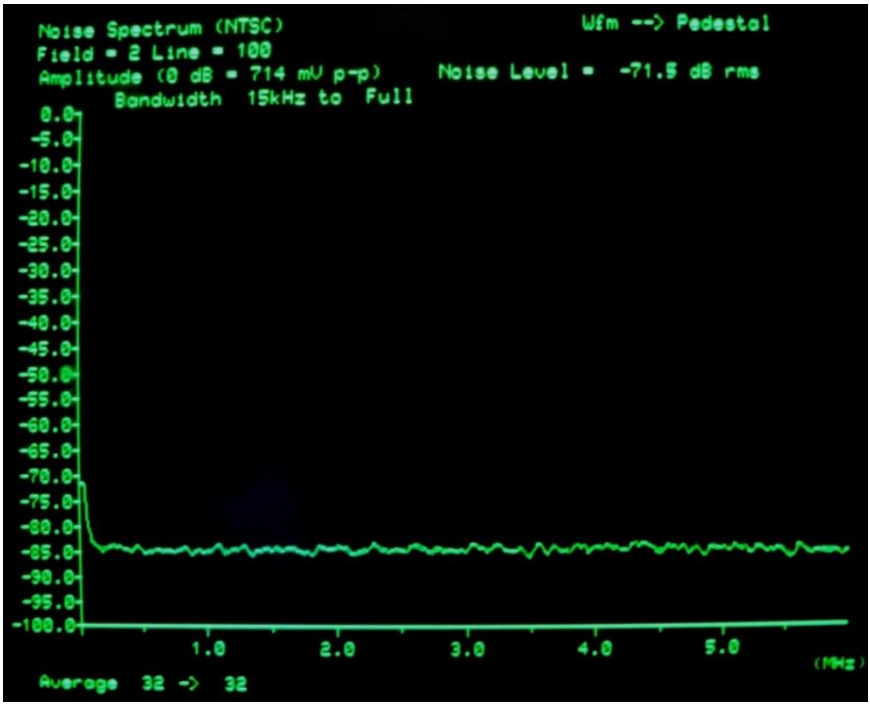


Figure 40 NTSC noise measurement (Pedestal waveform).

Figure 41 Luma frequency response (CCIR18 test signal).

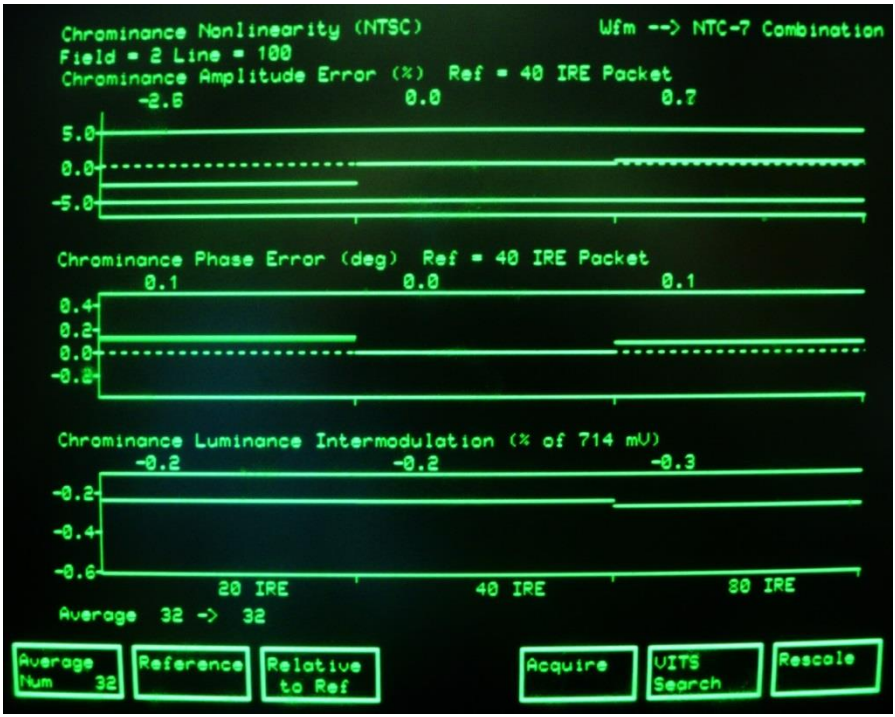


Figure 42 Chrominance non-linearity (using N7C-Combination test signal).

The SDI output measurements, (measured using a Tektronix WFM700M), are shown in Figures 43 to 46.

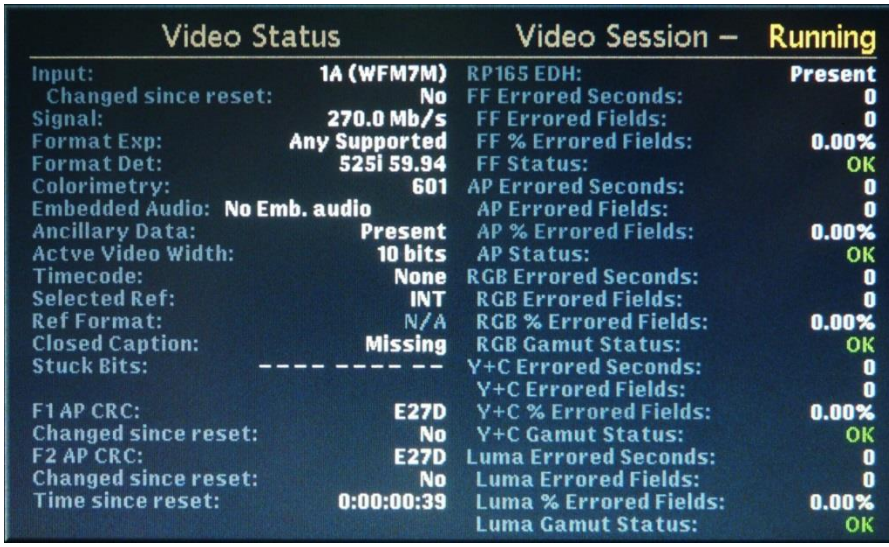


Figure 43 SDI output 525 line format measurement

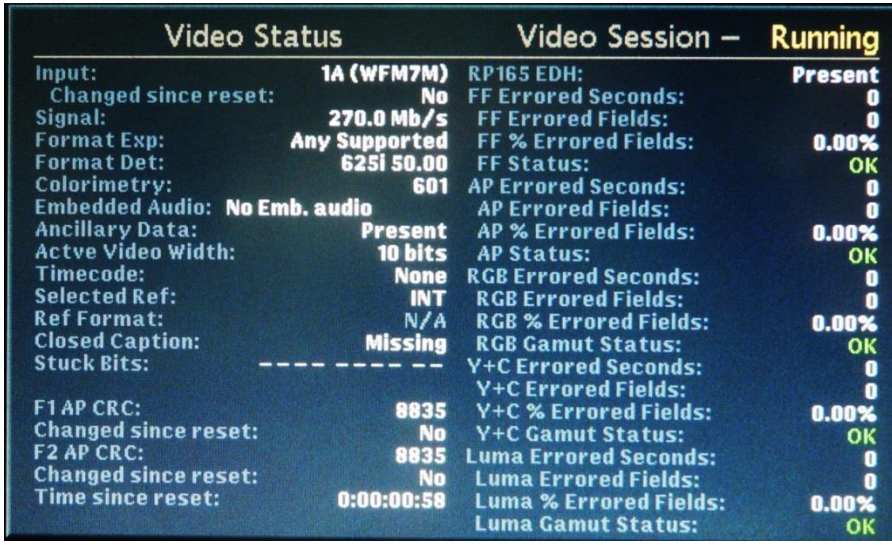


Figure 44 SDI output 625 line format measurement

Figure 45 SDI output 625 line eye pattern

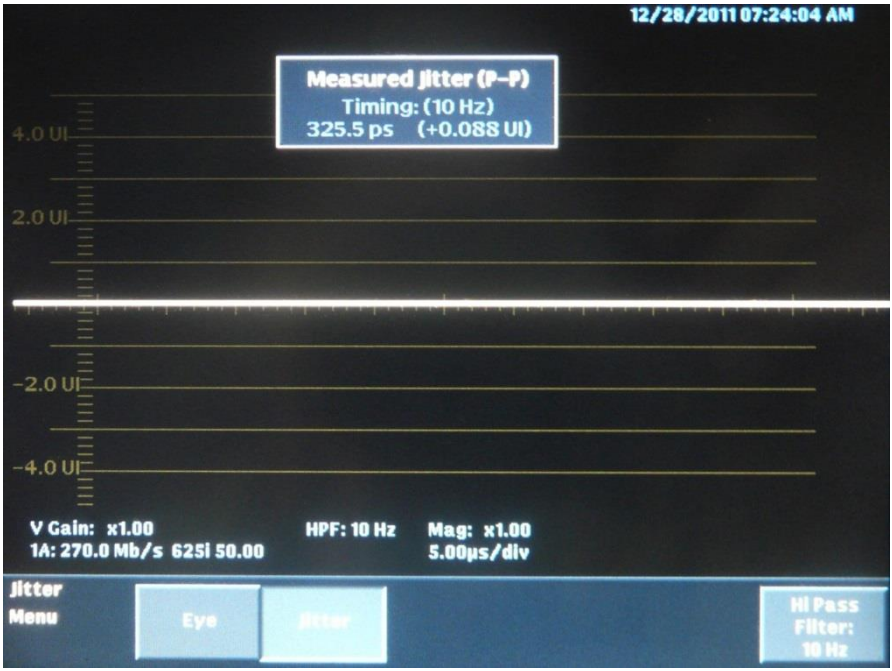


Figure 46 SDI output 625 line jitter measurement

Appendix B: Power supply specification

The AC-DC converter supplied with the SM01 is a model MW173KB from SL Power Electronics Corporation. It accepts all AC inputs from 100-240VAC and provides a 9V, 3A DC output for the SM01. The detailed specification is shown below.

MW173KB

Universal 20 – 32 Watt Series

Medical Switch-Mode Power Supply

3 Year Warranty

- *100-240VAC Universal Input*
- *Desktop Style*
- *5V to 24V Single Output Models, up to 32W*
- *Modified and Custom Designs*
- *Regulated Output with Low Ripple*
- *Impact-Resistant Polycarbonate Enclosure*
- *No load Power Consumption < 0.50W*
- *Designed to meet EISA Requirements (see page 3 for details).*

International Safety Standard Approvals

c UL us CE RoHS

AULT

Specifications

All Specifications are typical at nominal input, full load at 25°C unless otherwise stated.

Output Specifications

Line and Load Voltage Regulation	Excluding Cord	Line: +/-1% Load: +/-5%
Ripple		1% Vp-p max.
Transient Response		0.5mS for 50% Load Change, typical.
Protection		Overcurrent Protection (Hiccup). Short Circuit Protection

Input Specifications

Input Voltage Range	Universal Input	100-240VAC, -10%, +10%
Line Frequency		47-63Hz
Input Current	90 VAC	1.0A, max.
Protection		Internal Primary Current Fuse, Inrush Limiting

Environmental Specifications

Thermal Performance	Operating Temperature full load, no derating, convection cooling, Non-vented case	0° C to 40° C
Relative Humidity	Non-condensing	5% to 95%
Altitude		0 to 10,000 feet

General Specifications

Topology		Switching - Fixed Frequency Flyback
Efficiency		Designed to meet EISA Requirements - see page 3
Hold-up Time	@ 115VAC	18mS, min.
Dialectric Withstand		4,000VAC or 5,656VDC Primary-Secondary; 1,500VAC or 2,150VDC Primary - F.G; 500VDC Secondary - F.G.
Storage Temp.		-30° C to 85° C
Approvals and Safety Standards		UL60601-1 IEC/EN60601-1 EMC: EN60601-1-2/ EN55024
MTBF		100,000 Calculated Hours
Case and Dimensions		Desktop Style: 3.74"L x 2.13"W x 1.26"H 95mm L x 54mm W x 33mm H
Case Material		Black 94V0 Polycarbonate
Cord and Connectors		18AWG, 1,800mm 2 conductor. (5V, 6V model: 1,500mm). Ault #3 connector. Other connectors are available.

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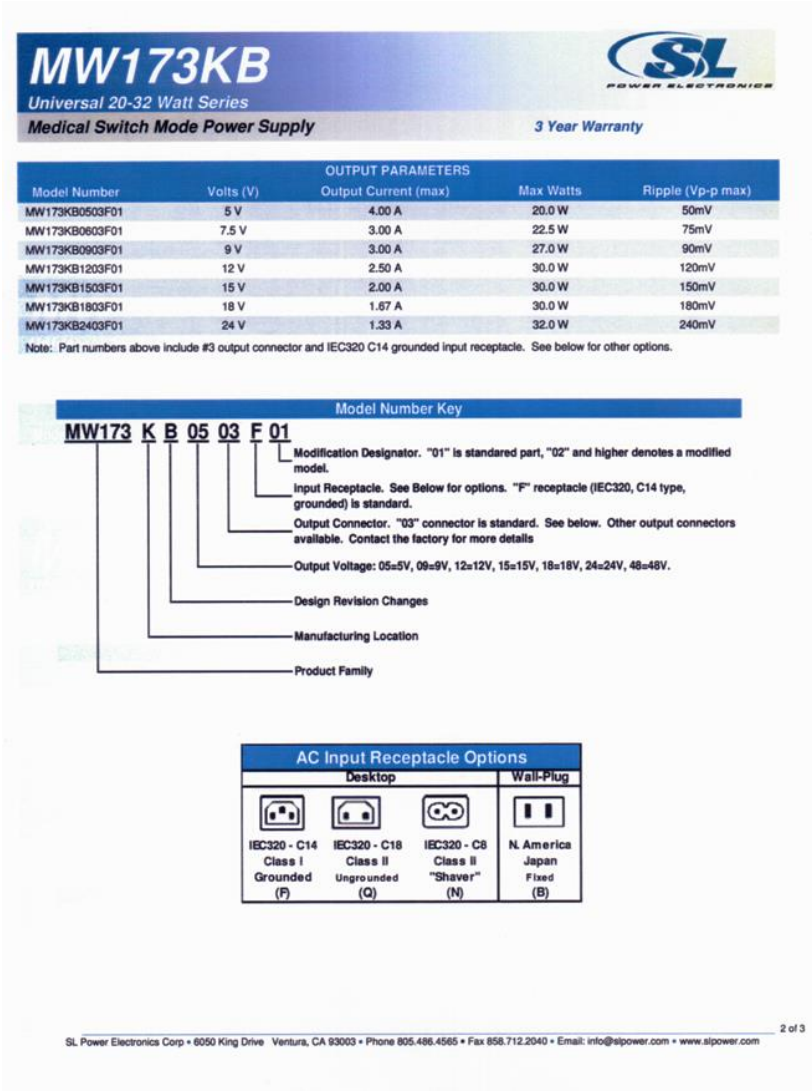
1 of 3

Figure 47 AC-DC converter specification: Page 1



MW173KB

Universal 20-32 Watt Series

Medical Switch Mode Power Supply

3 Year Warranty

OUTPUT PARAMETERS				
Model Number	Volts (V)	Output Current (max)	Max Watts	Ripple (Vp-p max)
MW173KB0503F01	5 V	4.00 A	20.0 W	50mV
MW173KB0603F01	7.5 V	3.00 A	22.5 W	75mV
MW173KB0903F01	9 V	3.00 A	27.0 W	90mV
MW173KB1203F01	12 V	2.50 A	30.0 W	120mV
MW173KB1503F01	15 V	2.00 A	30.0 W	150mV
MW173KB1803F01	18 V	1.67 A	30.0 W	180mV
MW173KB2403F01	24 V	1.33 A	32.0 W	240mV

Note: Part numbers above include #3 output connector and IEC320 C14 grounded input receptacle. See below for other options.

Model Number Key

MW173 K B 05 03 F 01

- **01** — Modification Designator. "01" is standared part, "02" and higher denotes a modified model.
- **F** — Input Receptacle. See Below for options. "F" receptacle (IEC320, C14 type, grounded) is standard.
- **03** — Output Connector. "03" connector is standard. See below. Other output connectors available. Contact the factory for more details
- **05** — Output Voltage: 05=5V, 09=9V, 12=12V, 15=15V, 18=18V, 24=24V, 48=48V.
- **B** — Design Revision Changes
- **K** — Manufacturing Location
- **MW173** — Product Family

AC Input Receptacle Options

Desktop			Wall-Plug
IEC320 - C14 Class I Grounded (F)	IEC320 - C18 Class II Ungrounded (Q)	IEC320 - C8 Class II "Shaver" (N)	N. America Japan Fixed (B)

2 of 3

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Figure 48 AC-DC converter specification: Page 2

MW173KB

Universal 20-32 Watt Power Supply

Medical Switch Mode Power Supply

3 Year Warranty

2007 Energy Independence and Security Act - EISA

The Energy Independence and Security Act of 2007 was passed in December of 2007 and addresses minimum efficiency standards and standby levels for Class A external power supplies that are 250 Watts and under. This law stipulates that external power supplies manufactured on July 1, 2008 and beyond meet certain minimum efficiency and standby criteria as defined below.

Minimum Efficiency Criteria:

Active mode is defined as when a power supply's input is connected to a line voltage AC and it's output is connected to a DC or AC load, drawing a portion of the product's power output. Depending upon the power rating for the power supply, it must meet the minimum efficiency criteria outlined below.

Energy-Efficiency Criteria for Active Mode:

Output Power on Adapter Label	Minimum Average Efficiency Percentage
0 to < 1 Watt	≥ 0.50 * output power on the label
> 1 watt to ≤ 51 watts	≥ [0.09 * Ln (output power on adapter label)] + 0.50
> 51 watts	≥ 0.85

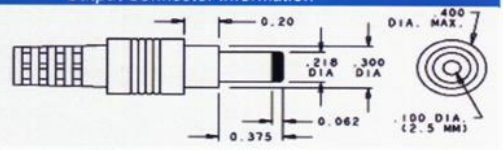
Energy Consumption Criteria for No Load Mode:

The power supply must also meet a requirement for when its input is connected to line voltage AC but its output is not connected to a load. Depending upon the power output of the supply, it must keep its energy consumption below the following values:

Output Power on Adapter Label	Maximum Power Consumption in No-Load Mode
0 to < 250 Watts	≤ 0.50 watts

Output Connector Information

3



Notes:

1. Center Contact = Positive
2. Connector is Switchcraft 760 plug or equivalent.
3. Suggested Mating Connector is Switchcraft 712A jack or equivalent.
4. Other output connector options are available. Contact your local representative for details.

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Figure 49 AC-DC converter specification: Page 3